ADDENDUM TO THE

ASSESSMENT OF THE POTENTIAL COSTS, BENEFITS, AND OTHER IMPACTS OF THE HAZARDOUS WASTE COMBUSTION MACT REPLACEMENT STANDARDS: PROPOSED RULE

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March 2004

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APPENDICES

INTRODUCTION

The purpose of this Addendum is to provide revised information on the costs and benefits of the Agency's proposed hazardous waste combustion (HWC) MACT replacement standards. This Addendum is necessary because we have revised the regulatory baseline as well as the total chlorine (TCl) and particulate matter (PM) standards evaluated in the 2004 *Assessment of the Potential Costs, Benefits, and Other Impacts of the Hazardous Waste Combustion MACT Replacement Standards: Proposed Rule* (the 2004 *Assessment*). This Addendum provides social cost and benefit estimates for six options: three floor options and three "beyond-the-floor" (BTF) options (including the Agency Preferred Approach). In addition, for each option cost estimates are estimated "with chlorine controls"and "without chlorine controls."[1] Note, however, that the changes in the PM and chlorine standards affect both the"with chlorine controls" and "without chlorine controls" versions of the standards. Finally, this Addendum includes a discussion of potential monetized benefits associated with reduced dioxin emissions under the proposed HWC MACT replacement standards.

The Addendum is organized into four sections. The first section discusses changes to the proposed chlorine and PM replacement standards and the regulatory baseline, as well as the rationale behind these changes. This section also provides revised estimates of the emissions reductions expected as a result of the replacement standards. The second section provides revised cost and benefit estimates and summarizes major changes in economic impacts relative to estimates presented in the 2004 *Assessment*. The third section of the Addendum discusses equity impacts of the proposed replacement standards and other pertinent regulatory concerns. The Addendum concludes with a presentation of revised cost-effectiveness estimates.

MAJOR CHANGES REFLECTED IN THE ADDENDUM

This Addendum provides results that reflect Agency revisions to the proposed HWC MACT replacement standards, regulatory baseline, and the emissions reductions anticipated in response to the revised standards. We discuss the nature and rationale for these changes below.

<u>Changes to the Proposed Replacement Standards</u>

We have altered our proposed standards for PM and chlorine. The modifications related to chlorine reflect the Agency's interpretation of beyond-the-floor cost-effectiveness, and the changes associated with PM are consistent with updates to EPA methods for estimating emissions.

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[1] All options include chlorine controls for HCl production furnaces. With or without chlorine controls pertains to §112(d)(4) of the Clean Air Act.

Revised Chlorine Standards

As illustrated in Exhibit 1, we have revised the proposed chlorine replacement standards for solid fuel boilers and lightweight aggregate kilns (LWAKs) under the Agency Preferred Approach. The revised chlorine standards under the Agency Preferred Approach do not require solid fuel boilers or LWAKs to meet a beyond-the-floor standard for chlorine. Therefore, the Agency Preferred Approach for solid fuel boilers is now 440 parts per million by volume (ppmv), compared to the standard of 110 ppmv presented in the 2004 *Assessment*. Similarly, the chlorine standard for LWAKs under the revised Agency Preferred Approach is 600 ppmv instead of 150 ppmv as presented in the 2004 *Assessment*. These changes reflect the Agency's determination that the beyond-the-floor standards for TCl are not cost-effective[2].

Revised PM Standards

The Agency has modified the proposed PM MACT replacement standards to reflect updated methods of characterizing the technical features of individual combustion systems. In developing the PM MACT replacement standards presented in the 2004 *Assessment*, the Agency relied upon a database containing detailed information on the performance characteristics of individual combustion systems, including the effectiveness of fabric filters installed at facilities that emit PM. Although several years' worth of data are available for several fabric filters, the PM standards analyzed in the 2004 *Assessment* reflect only the most recent performance data associated with each filter. Since completing the analysis for the 2004 *Assessment*, we have determined that estimates of fabric filter performance that account for less recent data would better represent the variation in fabric filter performance over time. The Agency has therefore augmented the summary of each fabric filter's performance with less recent data reflecting system trial burns, risk burns, and certification and compliance testing. Since MACT standards are based on the technological characteristics of the lowest emitting sources in the regulated universe, we have amended the previously established HWC MACT replacement standards for PM.

Exhibit 1 summarizes the updated PM replacement standards for the Agency Preferred Approach, as well as the PM standards evaluated under the Agency Preferred Approach in the 2004 *Assessment*. As Exhibit 1 indicates, the updated PM standards for most source categories under the Agency Preferred Approach are less stringent than the standards originally analyzed in the 2004 *Assessment*.

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[2] The Agency also considered the likelihood that solid fuel boiler and LWAK facilities may qualify for risk-based emission limits (instead of technology-based emissions limits) pursuant to §112(d)(4) of the Clean Air Act.

Exhibit 1

UPDATED AND PREVIOUS STANDARDS FOR PM AND CHLORINE REPLACEMENT MACT

MACT	**Source Category**	**Updated PM Standards (g/dscf)**	Previous PM Standards (g/dscf)	**Updated Cl Standards (ppmv)**	Previous Cl Standards (ppmv)
Agency Preferred Approach	Incinerators	0.015	0.010	1.5 ppmv	1.5 ppmv
	Cement Kilns	0.028	0.014	110 ppmv	110 ppmv
	LWAKs	0.025	0.017	600 ppmv	150 ppmv
	Solid Fuel Boilers	0.030	0.030	440 ppmv	110 ppmv
	Liquid Fuel Boilers	0.032	0.026	2.5E-2 lbs of Cl in HW per MMBtu in HW	2.5E-2 lbs of Cl in HW per MMBtu in HW
	HCl Production Furnaces	TCl as surrogate	TCl as surrogate	14 ppmv or 99.9927% SRE	14 ppmv or 99.9927% SRE

Consistent with less stringent PM standards, we have estimated new PM design levels for most source categories (i.e., the self-imposed emissions ceilings that systems try not to surpass to ensure that they do not violate the standards).[3,4] These revised design levels affect our cost analysis; lower design levels (i.e., more stringent design levels) require facilities to install more expensive (and more effective) abatement technologies. For most source categories, the revised design levels are less stringent relative to those associated with the PM standards evaluated in the 2004 *Assessment*. However, because of methodological changes in estimating fabric filter effectiveness, as outlined above, the updated PM design level for liquid boilers is lower (i.e., more stringent) than that estimated for the 2004 *Assessment*.[5] In the updated analysis, we estimate a liquid boiler PM design level of 0.0127 grams per dry square cubic foot (g/dscf) to meet the proposed standard of 0.032 g/dscf, whereas we previously estimated a design level of 0.014 g/dscf. Because of this decline in the estimated liquid boiler PM design level, the estimates of liquid boiler compliance costs presented in the following section exceed those presented in the 2004 *Assessment*.

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3 Design levels for the proposed HWC MACT replacement standards are estimated as the average performance of the top performing systems.

4 Design levels are usually represented as a percentage of the regulatory standard. For example, a firm with a design level of 70 percent would attempt to meet an emissions standard of 0.010 g/dscf by targeting an emissions level of 0.007.

5 In this case, fabric filter performance in more recent years appears to have decreased from previous levels.

Changes to the Regulatory Baseline

In addition to revising the replacement standards, we have applied revised assumptions and methods to the regulatory baseline, which assumes full compliance with the 2002 Interim Standards. More specifically, the 2002 baseline has been altered to reflect both design level changes and improvements in data quality.

Typically, a regulatory baseline reflects data about the state of the regulated industry or industries prior to the regulation's development. However, development of the proposed HWC MACT replacement standards overlaps with the implementation of the 2002 Interim Standards. The Agency, therefore, developed baseline conditions (e.g., baseline emissions) reflecting facilities' expected responses to the 2002 Interim Standards. To maintain consistency with the analysis of the proposed replacement standards, we have assumed that ratios of design levels to standards for the 2002 Interim Standards are the same as those associated with the proposed replacement standards.[6] Since the ratios associated with the replacement standards have changed, we re-estimated design levels associated with the 2002 Interim Standards. This modification changes estimates of both the reduction in PM emissions achieved in response to the 2002 Interim Standards and the baseline PM emissions assumed for the analysis of the proposed HWC MACT replacement standards. Note that boilers and HCl production furnaces are not affected by this methodological change because these systems are not regulated under the 2002 Interim Standards.

We have also modified estimates of baseline metals emissions from boilers and HCl production furnaces to reflect changes in the management of non-detect data points for these emissions.[7] In developing the baseline metals emissions presented in the 2004 *Assessment*, we received several non-detect data points from boilers and HCl production furnaces. When coding these data, the Agency assumed that the corresponding detection limits would reasonably approximate the non-detected metals emissions of each combustion system. However, several boilers and HCl production furnaces employed rudimentary measurement techniques incapable of capturing small yet detectable metals emissions. If these facilities had used more advanced measurement techniques, they would have applied a smaller detection limit to their non-detect data points. Therefore, the conservative assumption that non-detected emissions were equal to the high detection limits associated with the rudimentary measurement techniques likely overstated actual emissions associated with non-detect data points. The Agency has therefore re-coded boilers' non-detect data points for metals emissions as half the detection limit, which represents the central tendency between zero emissions and the detection limit.

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6 Design levels for the 2002 Interim Standards were estimated as the product of the 2002 Interim Standards and the ratio of the design level of the proposed replacement standards to the proposed replacement standards themselves. For example, the cement kiln design level for chlorine under the proposed replacement standards is 66 ppmv, and the proposed chlorine replacement standards for cement kilns is 110 ppmv. Since the 2002 Interim Standard for cement kiln emissions of chlorine is 130 ppmv, the corresponding design level associated with the 2002 Interim Standards is 130 ppmv*(66 ppmv)/(110 ppmv), or 78 ppmv.

7 Non-detect data points are those below the discernable limits of emission measurement tools. The level below which quantified measurements are not possible is referred to as the detection limit.

Exhibit 2 presents the revised baseline emissions estimates (i.e., emissions expected in the presence of the 2002 Interim Standards) that reflect the changes to the design levels and the refined treatment of non-detect emissions data. As Exhibit 2 shows, current estimates of baseline PM emissions from cement kilns and incinerators are lower than those presented in the 2004 *Assessment*. These reductions reflect the updated PM design levels for these systems; we now estimate more stringent cement kiln and incinerator PM design levels of 0.0115 g/dscf and 0.00315 g/dscf respectively for the 2002 Interim Standards, compared to the estimates of 0.0214 g/dscf and 0.0033 g/dscf prepared for the 2004 *Assessment*. In contrast, the increase in baseline PM emissions from LWAKs reflects a less stringent LWAK PM baseline design level of 0.0105 g/dscf compared to 0.0088 g/dscf in the 2004 *Assessment*. Since metals are included in PM, several of the revised baseline metals emissions estimates are lower than those presented in the 2004 *Assessment*. As illustrated in Exhibit 2, revised estimates of baseline semi-volatile metals (SVM), low-volatile metals (LVM), and mercury emissions for boilers are lower than those presented in the 2004 *Assessment*. Across most other source categories, estimates of baseline LVM emissions are also lower than estimates in the 2004 *Assessment*.

Exhibit 2

BASELINE EMISSIONS SUMMARY - PROPOSED HWC MACT REPLACEMENT STANDARDS[a]

		Cement Kilns	LWAKs	Commercial Incinerators	On-site Incinerators	Boilers and Process Heaters	HCl Production Furnaces	TOTAL
Dioxins/ Furans (g/yr)	Revised Estimate	4.6	2.1	0.6	1.0	2.0	2.6	12.9
	2004 *Assessment* Estimate	4.6	2.1	0.6	1.0	2.0	2.6	12.9
Particulate Matter (pounds/year)	Revised Estimate	1,700,000	44,000	63,000	151,000	6,800,000	80,000	8,800,000
	2004 *Assessment* Estimate	2,700,000	36,000	69,000	158,000	6,800,000	80,000	9,800,000
Mercury (pounds/year)	Revised Estimate	1,840	25	620	592	1,690	7	4,800
	2004 *Assessment* Estimate	1,840	25	620	592	1,793	7	4,900
Semi-Volatile Metals (pounds/year)	Revised Estimate	8,100	112	580	726	6,100	36	15,600
	2004 *Assessment* Estimate	8,400	108	579	736	7,700	36	17,500
Low-Volatile Metals (pounds/year)	Revised Estimate	513	67	331	565	29,100	150	30,700
	2004 *Assessment* Estimate	712	66	335	581	31,000	150	32,700
Chlorine (pounds/year)	Revised Estimate	3,800,000	835,000	106,000	485,000	10,700,000	306,000	16,200,000
	2004 *Assessment* Estimate	3,800,000	835,000	106,000	485,000	10,700,000	306,000	16,200,000

Notes:
a. Emissions estimates are presented in pounds per year for all pollutants, except dioxins/furans, which are presented in grams per year.

Changes in Emissions Projections

We have changed projections of the emissions reductions achieved in response to the standards to reflect the changes to the regulatory baseline and the proposed HWC MACT replacement standards have been revised,. Exhibit 3 presents the updated projections of the percentage reduction in emissions, by pollutant and source category. In addition, Appendix C to this Addendum provides numerical estimates (in tons) of the emissions reductions achieved under the revised HWC MACT replacement standards. For some pollutants, these revised projections represent a significant change from the projections presented in the 2004 *Assessment*. For example, under the Agency Preferred Approach of the replacement standards, we no longer expect reductions in PM emissions from LWAKs or incinerators (commercial and on-site). In the 2004 *Assessment*, the Agency projected that PM emissions would fall by at least 25 percent for each of these sources. Furthermore, the Agency now expects cement kiln PM emissions to fall by approximately 5 percent, compared to the 40-45 percent reduction reported in the 2004 *Assessment*. In contrast, the reduction in boiler PM emissions will be slightly greater under the revised HWC MACT replacement standards than projected in the 2004 *Assessment*.

These changes in PM projections affect the Agency's SVM and LVM emissions projections. Since SVM and LVM are distributed within PM, metals emissions fluctuate with changes in PM emissions. Consequently, we now expect cement kiln SVM emissions to fall by 20-30 percent, compared to the 45-55 percent reduction presented in the 2004 *Assessment*. Similarly, the Agency's revised estimate of the reduction in cement kiln LVM emissions is approximately one-third lower than the corresponding estimate in the 2004 *Assessment*. LVM emissions from LWAKs and incinerators are now expected to decline by less than 10 percent, instead of by 23-28 percent as previously estimated. The emissions reductions presented in Exhibit 3 do not capture the 5.4 tons of reduced non-enumerated metals emissions associated with the revised PM standards.[8]

Projected emissions reductions for chlorine have also changed relative to those presented in the 2004 *Assessment*, reflecting EPA's decision to eliminate beyond-the-floor chlorine controls for solid fuel boilers and LWAKs. As Exhibit 3 indicates, the Agency now expects no reduction in LWAK's chlorine emissions under the Agency Preferred Approach, compared to the reduction of nearly 70 percent associated with the LWAK chlorine standard presented in the 2004 *Assessment*. Similarly, we now expect a 20 percent reduction in boiler emissions of chlorine; the 2004 *Assessment* reported an estimated 35 percent reduction. The analytical assumption supporting these modifications to projected chlorine emissions also eliminates the 22,000 ton-per-year reduction in SO_2 emissions that would have been achieved under the version of the Agency Preferred Approach analyzed in the 2004 *Assessment*.[9]

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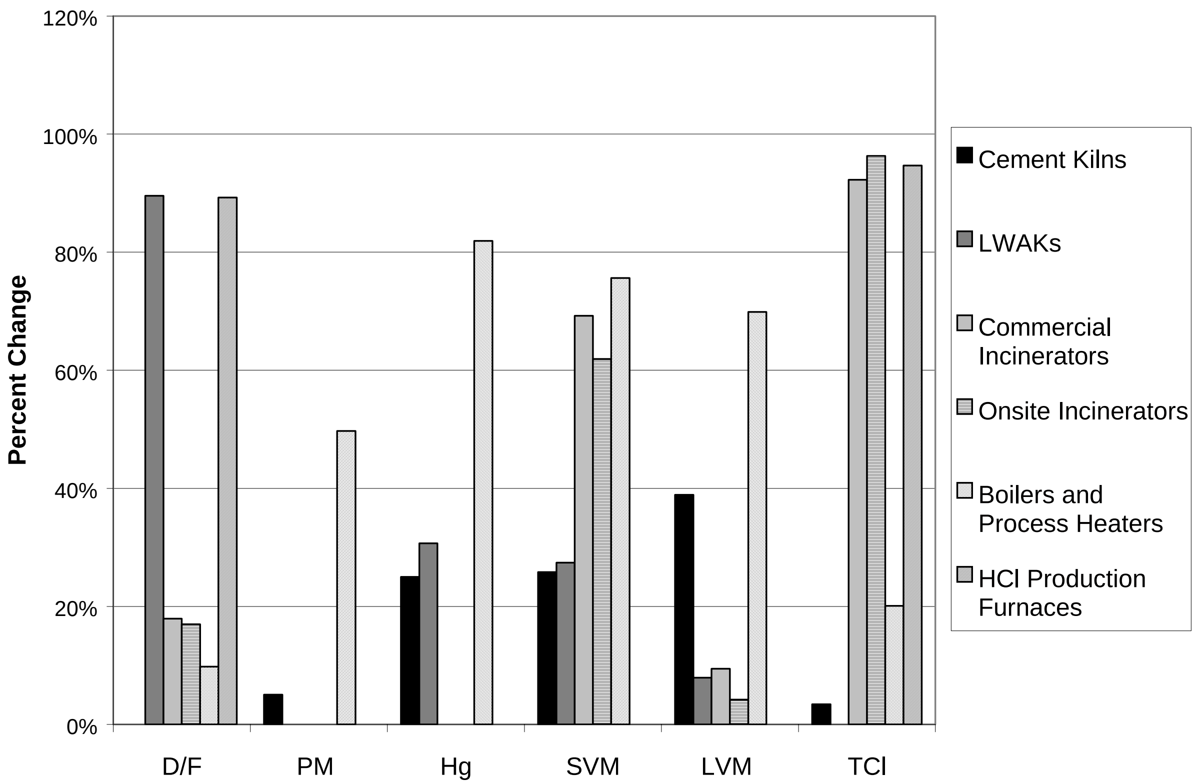
[8] Non-enumerated metals include manganese, cobalt, nickel, selenium, and antimony.

[9] In addition to the emissions reductions presented in the 2004 *Assessment*, solid fuel boilers' compliance with the chlorine standards under the Agency Preferred Approach proposed in the 2004 *Assessment* would reduce SO_2 emissions by approximately 22,000 tons per year as a result of the implementation of dry scrubber systems to control chlorine. Appendix A to this Addendum contains an analysis of the benefits

Exhibit 3

PERCENT CHANGE IN AGGREGATE EMISSIONS UNDER AGENCY PREFERRED APPROACH



For on-site and commercial incinerators, cement kilns, and LWAKs, percent change in emissions is relative to the 2002 Interim Standards. For boilers and HCl production furnaces, percent change is relative to the 1991 RCRA Boiler and Industrial Furnaces rule.

REVISED COST AND BENEFIT ESTIMATES

The cost and benefit estimates presented in this document are consistent with the analytical framework described in Chapters 4, 5, and 6 of the 2004 *Assessment*. Detailed model results are included in Appendix B to this Addendum. Additional information on the economic model used to develop cost estimates is available in Appendix D of the 2004 *Assessment*.

associated with this reduction in SO_2 emissions. Note, however, that these reductions are not anticipated under the updated Agency Preferred Approach that eliminates beyond the floor (BTF) standards for coal-fired boilers and LWAKs.

Major findings of the current analysis are as follows:

- The analysis now estimates upper bound engineering costs of $77.9 million per year for the Agency Preferred Approach with chlorine controls. This represents an 8.9 percent reduction compared to the estimate of $85.5 million presented in the 2004 *Assessment*.

- Market-adjusted costs of the Agency Preferred Approach with chlorine controls are now estimated to be approximately $50.0 million, which is approximately 13.2 percent lower than the $57.6 million estimate presented in the 2004 *Assessment*.

- Boilers and HCl production furnaces bear approximately 83 percent ($41.5 million) of the costs of the proposed replacement standards. This reflects the fact that these facilities are not subject to any emissions requirements under the 2002 Interim Standards. In addition, the $41.5 million estimate is 5.5 percent less than the $43.9 million estimate in the 2004 *Assessment* because of the elimination of beyond-the-floor chlorine standards for solid fuel boilers.

- Estimates of economic impacts are largely unchanged from those in the 2004 *Assessment*. Estimated employment gains are now approximately 6 percent lower under the Agency Preferred Approach. In addition, the analysis now projects an increase of 1.05 percent in combustion pricing, as opposed to the 1.4 percent increase presented in the 2004 *Assessment*.

- Monetized health benefits associated with the Agency Preferred Approach are approximately $4.50 million.[10] This estimate is approximately 8.2 percent greater than that presented in the 2004 *Assessment*.

- Visibility benefits associated with the revised Agency Preferred Approach of the replacement standards range from $106,300 per year to $5.78 million per year. These two figures represent two different methodologies for estimating visibility benefits. Estimates in the 2004 *Assessment* ranged from $105,800 to $7.41 million per year.

<u>Revised Cost Analysis</u>

Revised engineering and market-adjusted cost estimates are presented in Exhibit 3 and Exhibit 4. The market-adjusted costs included in these exhibits reflect a 100 percent cost pass-

[10] The avoided mortality benefits included in this estimate were calculated in 1999 dollars, in contrast to estimated morbidity benefits and estimated social costs, which were estimated in 2002 dollars. Therefore, estimated total benefits are not comparable to estimates of costs.

through consistent with the market-adjusted costs presented in Exhibit 5-7 of the 2004 *Assessment*. Under the revised PM replacement standards, total costs for each option included in the 2004 *Assessment* have decreased. The engineering costs of the Agency Preferred Approach with chlorine controls are now estimated at $77.9 million per year, compared to $85.5 million in the 2004 *Assessment*. Similarly, the total social costs of the Agency Preferred Approach with chlorine controls are now approximately $50.0 million per year, compared to $57.6 million per year in the 2004 *Assessment*.

Engineering Costs

Annualized engineering costs with chlorine controls range from $72.1 million per year under the Option 1 Floor to approximately $130.5 million per year under the Option 3 "beyond the floor" (BTF). Without controls on chlorine, annual engineering costs range from $52.7 million under the Option 1 Floor to $82.9 million under Option 3 BTF. When chlorine controls are included in the standards, costs of the BTF versions of Options 1, 2, and 3 are 8.0 percent, 5.0 percent, and 5.1 percent greater than costs associated with their corresponding floor options.[11] Without chlorine controls, these differentials are 9.5 percent, 6.4 percent, and 6.7 percent, respectively.

Average per-system engineering costs associated with the revised Agency Preferred Approach with chlorine controls have changed for several source categories. Per-system costs for coal boilers are now $286,400, which represents a 46 percent reduction compared to the estimate of $528,009 per system presented in the 2004 *Assessment*. In addition, revised per system cement kiln engineering costs, approximately $245,400 per system, are 24 percent lower than the estimate of $323,700 presented in the 2004 *Assessment*. Commercial and on-site incinerator per-system engineering costs, $239,400 and $135,800 respectively, are now approximately $20,000 lower than the corresponding estimates presented in the 2004 *Assessment*. Average LWAK engineering costs have fallen by $192,600 per system to $394,100. In contrast, per-system engineering costs for liquid boilers, $378,300, have increased by approximately 3.3 percent relative to the estimate of $366,000 per system presented in the 2004 *Assessment*. Per-system engineering costs for HCl production furnaces are unchanged.

Social Costs

Market-adjusted costs when the standards include chlorine controls range from $46.4 million under the Option 1 Floor to $94.7 million under Option 3 BTF. Without chlorine controls, this range is $36.2- $64.9 million. As mentioned above, annual social costs associated with the Agency Preferred Approach with chlorine controls are $50.0 million. These costs are approximately 7.8 percent more than the costs of the Option 1 Floor and approximately 36 percent lower than the engineering costs of the Agency Preferred Approach.

11 As explained in the 2004 *Assessment*, the Agency Preferred Approach is the beyond-the-floor version of the Option 1 Floor.

Compared to estimates presented in the 2004 *Assessment*, market-adjusted costs for cement kilns and on-site incinerators under the Agency Preferred Approach are now slightly lower. Similarly, estimates of coal boiler and LWAK costs are also lower, reflecting the elimination of beyond-the-floor chlorine controls for these sources. In contrast, current estimates of liquid boiler costs are higher than their corresponding estimates in the 2004 *Assessment* due to a lower (i.e., more stringent) estimate of the PM design level for liquid boilers under the replacement standards. Our estimate of commercial incinerator savings is now slightly lower since combustion prices do not increase as much under the revised standards. Estimates of HCl production furnace costs are unchanged.

Distribution of Costs

Among source categories, boilers and HCl production furnaces bear the most significant portion of total engineering and market-adjusted costs associated with the proposed HWC MACT replacement standards. This distribution of costs reflects the focus of past regulation on incinerators and commercial kilns. The 2002 Interim Standards did not regulate boilers and HCl production furnaces; the proposed replacement standards are the first hazardous waste combustion MACT regulations to address these systems.

Under the Agency Preferred Approach, boiler and HCl production furnace engineering costs represent approximately two-thirds of total engineering costs. This figure increases to 80 percent of engineering costs when chlorine controls are not included in the Agency Preferred Approach. Similarly, boilers and HCl production furnaces incur 83 percent of total social costs under the Agency Preferred Approach and more than 92 percent of social costs when chlorine controls are excluded from these standards. Boilers and HCl production furnaces represent a higher percentage of market-adjusted costs than engineering costs because these systems, unlike commercial incinerators and commercial kilns, are unable to offset engineering costs by managing waste commercially.

Exhibit 4

SUMMARY OF SOCIAL COST ESTIMATES - With Chlorine Controls
(millions of 2002 dollars)

		Cement Kilns[a]	LWAKs[a]	Commercial Incinerators[b]	On-site Incinerators	Liquid Boilers	Coal Boilers	HCl Production Furnaces	Generators that currently send waste to commercial facilities	TOTAL[c]
Option 1 Floor	Market-adjusted Costs	($2.7)	($0.1)	($10.6)	$9.1	$36.7	$1.5	$1.5	$10.6	$46.4
	Engineering Costs	$6.5	$0.5	$3.7	$12.8	$44.7	$1.8	$1.5	NA	$72.1
Agency Preferred Approach	Market-adjusted Costs	($5.4)	$1.5	($11.4)	$9.1	$36.8	$1.3	$3.4	$14.2	$50.0
	Engineering Costs[d]	$6.5	$2.8	$3.7	$12.8	$44.9	$3.4	$3.4	NA	$77.9
Option 2 Floor	Market-adjusted Costs	$0	($1.1)	($14.9)	$11.7	$47.2	$1.5	$1.8	$33.2	$80.0
	Engineering Costs	$28.0	$0.8	$4.7	$16.6	$60.4	$1.8	$1.8	NA	$114.7
Option 2 BTF	Market-adjusted Costs	($2.4)	$0.2	($15.5)	$11.7	$47.4	$1.3	$3.4	$36.6	$83.0
	Engineering Costs[d]	$28.0	$3.0	$4.7	$16.6	$60.7	$3.4	$3.4	NA	$120.4
Option 3 Floor	Market-adjusted Costs	$1.7	($1.1)	($15.2)	$12.2	$54.7	$1.5	$1.8	$35.3	$91.3
	Engineering Costs	$29.7	$0.9	$4.8	$17.0	$67.6	$1.8	$1.8	NA	$124.2
Option 3 BTF	Market-adjusted Costs	($0.9)	$0.1	($15.9)	$12.2	$54.9	$1.3	$4.1	$38.5	$94.7
	Engineering Costs[d]	$29.7	$3.1	$4.8	$17.0	$67.8	$3.4	$4.1	NA	$130.5

NOTES:

a. Social cost estimates presented here are adapted from estimates that reflect the change in the proposed PM standards but not the change in the proposed chlorine standards for coal boilers and LWAKs. To generate our estimate, we subtracted the incremental, floor to beyond-the-floor LWAK and coal boiler chlorine control costs estimated in the 2004 *Assessment* from social cost estimates that reflected the updated PM proposal but not the updated chlorine proposal.

b. Social cost estimates for commercial systems reflect simplifying assumptions that all commercial facilities are able to charge the same prices for each waste type (e.g., "halogenated waste") and are able to increase prices in order to offset cost increases. These estimates may understate social costs to commercial kilns if these systems are unable to increase prices and charge lower prices for waste with lower halogen content. However, while commercial kiln costs reflect some uncertainty, total social costs estimates are not significantly affected, because changes in assumptions about commercial kiln combustion pricing generally reflect a transfer from waste generators to kilns. The Economic Assessment developed for this rule describes a sensitivity analysis that addresses the uncertainty associated with cement kiln costs.

c. Totals will not add due to rounding. In addition, government administrative costs are included in the total social cost estimates. Government costs range from $420,000 to $447,000 per year across all six options. For the upper bound estimate, under which all systems upgrade, annual government costs are approximately $543,000.

d. Updated estimates of beyond-the-floor engineering costs are available in U.S. EPA, "Technical Support Document for the HWC MACT Standards, Volume V: Emission Estimates and Engineering Costs," February 2004. The updated results in the technical support document reflect co-control cost savings associated with beyond-the-floor dioxin controls for LWAKs and beyond-the-floor PM controls for coal boilers. Under the Agency Preferred Approach, updated engineering costs are approximately $77.2 million.

Exhibit 5

SUMMARY OF SOCIAL COST ESTIMATES - No Chlorine Controls
(millions of 2002 dollars)

		Cement Kilns[a]	LWAKs[a]	Commercial Incinerators[a]	On-site Incinerators	Liquid Boilers	Coal Boilers	HCl Production Furnaces	Generators that currently send waste to commercial facilities	TOTAL[b]
Option 1 Floor	Market-adjusted Costs	($0.7)	$0.1	($7.0)	$1.0	$32.6	$1.0	$1.5	$7.4	$36.2
	Engineering Costs	$5.9	$0.5	$1.0	$1.5	$40.3	$1.3	$1.5	NA	$52.7
Agency Preferred Approach	Market-adjusted Costs	($2.0)	$1.7	($7.4)	$1.0	$32.7	$2.2	$3.4	$9.2	$41.1
	Engineering Costs	$5.9	$2.3	$1.0	$1.5	$40.4	$2.6	$3.4	NA	$57.7
Option 2 Floor	Market-adjusted Costs	$1.3	($0.4)	($9.1)	$3.4	$33.2	$1.0	$1.8	$20.4	$52.3
	Engineering Costs	$17.7	$0.8	$2.0	$4.8	$41.1	$1.3	$1.8	NA	$70.2
Option 2 BTF	Market-adjusted Costs	$0.2	$1.0	($9.4)	$3.4	$33.4	$2.2	$3.4	$21.9	$56.6
	Engineering Costs	$17.7	$2.3	$2.0	$4.8	$41.3	$2.6	$3.4	NA	$74.7
Option 3 Floor	Market-adjusted Costs	$1.2	($0.4)	($9.4)	$4.0	$39.2	$1.0	$1.8	$22.4	$60.1
	Engineering Costs	$19.5	$0.9	$2.1	$5.5	$46.0	$1.3	$1.8	NA	$77.7
Option 3 BTF	Market-adjusted Costs	($0.1)	$0.9	($9.7)	$4.0	$39.3	$2.2	$4.1	$23.8	$64.9
	Engineering Costs	$19.5	$2.3	$2.1	$5.5	$46.2	$2.6	$4.1	NA	$82.9

NOTES:

a. Social cost estimates for commercial systems reflect simplifying assumptions that all commercial facilities are able to charge the same prices for each waste type e.g., "halogenated waste") and are able to increase prices in order to offset cost increases. These estimates may understate social costs to commercial kilns if these systems are unable to increase prices and charge lower prices for waste with lower halogen content. However, while commercial kiln costs reflect some uncertainty, total social costs estimates are not significantly affected, because changes in assumptions about commercial kiln combustion pricing generally reflect a transfer from waste generators to kilns. The Economic Assessment developed for this rule describes a sensitivity analysis that addresses the uncertainty associated with cement kiln costs.

b. Totals will not add due to rounding. In addition, government administrative costs are included in the total social cost estimates. Government costs range from $427,000 to $455,000 per year across all six options. For the upper bound estimate, under which all systems upgrade, annual government costs are approximately $543,000.

Revised Economic Impact Estimates

Estimates of economic impacts change very little from those included in the 2004 *Assessment*. Estimated employment gains decrease by approximately 3 percent to 559 full-time equivalents under the revised Agency Preferred Approach.[12] This reflects the fact that with less stringent PM standards for several facilities, fewer labor resources will be required to comply with the standards. In addition, we now estimate that combustion prices may increase by approximately 1.05 percent as a result of the replacement standards, compared to the projected 1.4 percent increase reported in the 2004 *Assessment*.[13] Market exits are virtually unchanged from exits reported in the 2004 *Assessment*. Since market exits do not change considerably, the estimated quantity of hazardous waste reallocated (e.g., 120,855 tons under the Agency Preferred Approach) does not change as a result of the changes to the proposed standards.

Most of the revised estimates of other industry impacts (e.g., changes in the profitability and cost structure of the combustion industry) are similar to estimates presented in the 2004 *Assessment*. However, we now estimate that cement kiln and commercial incinerator waste burning costs may increase by 10.3 percent and 1.3 percent respectively, compared to the potential increases of 14 percent and 3.9 percent reported in the 2004 *Assessment*. In addition, the Agency now estimates a possible 9 percent increase in cement kiln pollution control costs. This is nearly 3 percentage points lower than the 11.9 percent increase that we had previously estimated in the 2004 *Assessment*.

Revised Benefits Analysis

This section provides updated estimates of the health and visibility benefits associated with the revised replacement standards. The benefits analysis has been revised to include the following:

- Monetized benefits associated with reduced dioxin emissions,

- Revised estimates of benefits associated with reduced PM emissions, reflecting changes to the baseline and the proposed standards as outlined above,

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[12] This estimate reflects beyond-the-floor chlorine controls for LWAKs and coal boilers. Since the Agency has eliminated beyond-the-floor chlorine standards for these systems, estimated job gains may be lower than the estimate presented in this Addendum.

[13] This estimated price increase reflects the beyond-the-floor standard that the Agency considered for LWAKs. Since LWAKs are not required to meet beyond-the-floor chlorine controls under the revised Agency Preferred Approach, the estimated increase in commercial combustion prices may be lower than presented in this Addendum.

- Discounted estimates of benefits that are not immediately realized after emissions are reduced.

The results presented below include only those benefits associated with reduced PM and dioxin.[14] Although little information is available on the potential magnitude of benefits associated with reduced emissions of the other pollutants included in the standards, reductions in the emissions of these pollutants are likely to improve human health. For example, adverse health effects associated with hydrogen chloride exposure are well documented. These include eye, nose, and respiratory tract irritation; pulmonary edema; gastritis; bronchitis; and dermatitis. Prolonged exposure to low concentrations of hydrogen chloride may also lead to dental discoloration and erosion. The benefits associated with reducing the incidence of these ailments are likely to be lower under the "without chlorine controls" version of each option than the corresponding "with chlorine controls" option.

Our estimates of the physical effects associated with the revised PM replacement standards are presented in Exhibit 6. The exhibit does not differentiate between "with chlorine controls" and "without chlorine controls" versions of the standards because none of the quantified benefits presented in Exhibit 6 are associated with reduced chlorine emissions.[15]

Most of the quantified reductions in physical effects reported in Exhibit 6 are slightly lower than the corresponding results presented in the 2004 *Assessment*, although the number of premature deaths is largely unchanged across all regulatory options. Differences between current and previous results are least pronounced under the Agency Preferred Approach. Compared to results presented in the 2004 *Assessment*, 0.1 fewer cases of chronic bronchitis and upper respiratory illness are avoided each year under the Agency Preferred Approach. In addition, 0.4 fewer work loss days and lower respiratory illness cases are avoided each year under the revised Agency Preferred Approach. Under the Option 1 Floor and the Option 2 Floor, annual reductions in lower respiratory illness, work loss days, and minor restricted activity are 0.8, 3.4, and 28 cases less respectively than estimates presented in the 2004 *Assessment*. Similarly, 0.1 fewer cases of acute and chronic bronchitis and upper respiratory illness are avoided under the revised Option 1 and 2 Floors. Results associated with the revised Option 3 Floor differ most significantly from the corresponding estimates presented in the 2004 *Assessment*. Our current estimate of 6,848.6 avoided minor restricted activity cases represents a decline of 438.6 avoided cases compared to the annual reductions presented in the 2004 *Assessment*. In addition, we now anticipate the avoidance of 52.6 fewer work loss days per year and of 5.1 fewer lower respiratory cases per year under the revised Option 3 Floor. Our

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[14] The revised estimates of SVM and LVM emissions reductions described above have no effect on monetized benefits estimates, which are based completely on estimated PM emission reductions.

[15] The "with chlorine controls" version of the standards analyzed in the 2004 *Assessment* may have reduced coal boiler emissions of SO_2. The benefits associated with this emissions reduction are not included in the 2004 *Assessment* or in the primary results of this Addendum but are provided in Appendix A of this Addendum.

current estimates of chronic and acute bronchitis cases avoided under this option are 0.7 and 0.6 annual cases less respectively than the estimates presented in the 2004 *Assessment*.

Exhibit 6

REDUCTION IN ANNUAL INCIDENCE OF PHYSICAL EFFECTS ASSOCIATED WITH PM

	Agency Preferred Approach	**Option 1 Floor**	**Option 2 Floor**	**Option 2 BTF-D**	**Option 3 Floor**	**Option 3 BTF-D**
Premature deaths avoided	0.3	0.3	0.3	0.3	0.6	0.6
Respiratory illness	0.9	0.9	0.9	0.9	1.6	1.6
Cardiovascular disease	0.4	0.4	0.4	0.4	0.7	0.7
Chronic bronchitis	5.6	5.5	5.5	5.6	10.3	10.4
Acute bronchitis	4.3	4.2	4.2	4.3	7.8	7.9
Lower respiratory symptoms	38.0	37.3	37.3	38.0	69.1	69.8
Upper respiratory symptoms	4.4	4.3	4.3	4.4	8.0	8.1
Work loss days	450.7	443.9	443.9	450.7	822.1	829.2
Minor restricted activity days	3,754.4	3,698.1	3,698.1	3,754.4	6,848.6	6,907.4
Restricted Activity days	1,236.4	1,217.9	1,217.9	1,236.4	2,255.4	2,274.8

The proposed replacement standards are also likely to reduce the number of cancer deaths associated with dioxin/furans emissions. The Addendum to the 1999 *Assessment* estimated that 0.36 premature cancer deaths would be avoided annually due to the annual emissions reduction of 28.7 grams of mass doxin/furans, associated with the 1999 dioxin/furan standards. Assuming that the proportional relationship between dioxin/furans emissions and premature cancer deaths is constant, we estimate that approximately 0.058 premature cancer deaths will be avoided on an annual basis under the Agency Preferred Approach because of reduced dioxin/furans emissions. This estimate reflects a cancer risk slope factor of 1.56×10^5 $[mg/kg/day]^{-1}$. This cancer slope factor is derived from the Agency's 1985 health assessment document for polychlorinated dibenzo-p- dioxins[16] and represents an upper bound 95th percentile confidence limit of the excess cancer risk from a lifetime exposure.

For the past 12 years the Agency has been conducting a reassessment of the human health

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16 USEPA, 1985. Health Assessment Document for Polychlorinated Dibenzo-p-Dioxins. EPA/600/8-84/014F. Final Report. Office of Health and Environmental Assessment. Washington, DC. September, 1985.

risks associated with dioxin and dioxin-like compounds. This reassessment[17] will soon be under review at the National Academy of Sciences (NAS), as specified by Congress in the Conference Report accompanying EPA's fiscal year 2003 appropriation (Title IV of Division K of the Conference Report for the Consolidated Appropriations Resolution of 2003). Evidence compiled from this draft reassessment indicates that the carcinogenic effects of dioxin/furans may be as much as six times as great as believed in 1985, reflecting an upper bound cancer risk slope factor of 1 x 10^6 [mg/kg/day]$^{-1}$ for some individuals. Agency scientists' more likely (central tendency) estimates (derived from the ED_{01} rather than the LED_{01}) result in slope factors and risk estimates that are within 2-3 times of the upper bound estimates (i.e., between 3 x 10^5 [mg/kg/day]$^{-1}$ and 5 x 10^5 [mg/kg/day]$^{-1}$) based on the available epidemiological and animal cancer data. Risks could be as low as zero for some individuals. Use of the alternative upper bound cancer risk slope factor would result in up to 0.35 premature cancer deaths avoided in response to the proposed replacement standards for dioxin/furans. The assessment of upper bound cancer risk using this alternative slope factor should not be considered Agency policy. The proposed standards for dioxin in today's rule were not based on this draft reassessment.

Our estimates of avoided premature cancer deaths associated with the proposed replacement standards for dioxin and various options are presented in Exhibit 7. However, since dioxin causes several other health effects, such as impaired development and reduced fertility, the values in Exhibit 7 are believed to underestimate the actual benefits associated with reduced dioxin/furans emissions.

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[17] U.S.EPA, *Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds*, September 2000. Note: Toxicity risk factors presented in this document should not be considered EPA's official estimate of dioxin toxicity, but rather reflect EPA's ongoing effort to reevaluate dioxin toxicity.

Exhibit 7

REDUCTION IN ANNUAL INCIDENCE OF PREMATURE CANCER DEATHS ASSOCIATED WITH DIOXIN/FURANS[a,b]

Agency Preferred Approach	Option 1 Floor	Option 2 Floor	Option 2 BTF-D	Option 3 Floor	Option 3 BTF-D
0.058	0.005	0.005	0.058	0.005	0.058

Notes:

a. The primary estimates assume that the proportional relationship between cancer deaths and dioxin/furans emissions is constant. All estimates rely on results of the risk analysis prepared for EPA, *Assessment of The Potential Costs, Benefits & Other Impacts of The Hazardous Waste Combustion MACT Standards: Final Rule*, July 1999.

b. As discussed in the text above, the Agency has been conducting a reassessment of the human health risks associated with dioxin and dioxin-like compounds. This reassessment will soon be under review at the National Academy of Sciences (NAS), as specified by Congress in the Conference Report accompanying EPA's fiscal year 2003 appropriation (Title IV of Division K of the Conference Report for the Consolidated Appropriations Resolution of 2003). Evidence compiled from this draft reassessment indicates that the carcinogenic effects of dioxin/furans may be as much as six times as great as believed in 1985, reflecting an upper bound cancer risk slope factor of 1×10^6 $[mg/kg/day]^{-1}$ for some individuals. Use of the alternative upper bound cancer risk slope factor would result in up to 0.35 premature cancer deaths avoided in response to the proposed replacement standards for dioxin/furans. The assessment of upper bound cancer risk using this alternative slope factor should not be considered Agency policy.

A detailed accounting of the monetized, non-discounted benefits of the revised replacement standards is presented in Exhibit 8. Our central estimate of the annual health benefits associated with the revised version of the Agency Preferred Approach is approximately $4.50 million, reflecting a range of $2.73 million to $6.27 million. The central estimate of $4.50 million represents an 8.2 percent increase over the annual benefits of $4.16 million reported in the 2004 *Assessment*. This increase in benefits reflects the monetization of avoided cancer deaths associated with reduced dioxin/furans exposure; these benefits were not monetized in the 2004 *Assessment*. Across all three beyond-the-floor options, our primary estimate of benefits associated with reduced dioxin emissions is $0.06 million to $0.58 million. Recent evidence suggests, however, that the toxicity of dioxin may be as much as six times greater than reflected in these estimates.[18] As explained above, we have also made minor modifications to baseline PM emissions and the proposed PM replacement

[18] U.S.EPA, *Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds*, September 2000. Note: Toxicity risk factors presented in this document should not be considered EPA's official estimate of dioxin toxicity, but rather reflect EPA's ongoing effort to reevaluate dioxin toxicity.

standards, but these changes have little impact on monetized benefits estimates since the current estimate of avoided mortalities is nearly the same as that presented in the 2004 *Assessment*.

Across the three floor options, we estimate health benefits ranging from approximately $2.64 million to $11.04 million, compared to the range of $4.12 million to $8.08 million presented in the 2004 *Assessment*. This range of benefits associated with the revised version of the proposed replacement standards reflects a VSL range of $1.0 million to $10.0 million. Benefits are greater under the beyond-the-floor versions of the replacement standards because the PM standards for solid fuel boilers and the dioxin/furans standards for LWAKs, liquid fuel boilers, and HCl production furnaces are more stringent under the BTF options.

Exhibit 8

MONETIZED NON-DISCOUNTED VALUE OF BENEFITS ASSOCIATED WITH THE PROPOSED HWC MACT REPLACEMENT STANDARDS
(2002 Dollars in Millions)[a]

Type of Benefit	Agency Preferred Approach	Option 1 Floor	Option 2 Floor	Option 2 BTF-D	Option 3 Floor	Option 3 BTF-D
Human Health Benefits - Particulate Matter[b]						
Premature deaths avoided[c]	$1.84 ($0.34 - $3.35)	$1.81 ($0.33 - $3.30)	$1.81 ($0.33 - $3.30)	$1.84 ($0.34 - $3.36)	$3.36 ($0.61 - $6.10)	$3.39 ($0.62 - $6.16)
Respiratory illness	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Cardiovascular disease	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Chronic bronchitis	$2.12	$2.09	$2.09	$2.12	$3.87	$3.91
Acute bronchitis	$0	$0	$0	$0	$0	$0
Lower respiratory symptoms	$0	$0	$0	$0	$0	$0.01
Upper respiratory symptoms	$0	$0	$0	$0	$0	$0
Work loss days	$0.05	$0.05	$0.05	$0.05	$0.09	$0.09
Minor restricted activity	$0.15	$0.15	$0.15	$0.15	$0.27	$0.27
Human Health Benefits - Dioxin/Furans						
Premature cancer deaths avoided (primary estimate)[d]	$0.32 ($0.06 - $0.58)	$0.03 ($0.01 - $0.05)	$0.03 ($0.01 - $0.05)	$0.32 ($0.06 - $0.58)	$0.03 ($0.01 - $0.05)	$0.32 ($0.06 - $0.58)
Annual Monetized Health Benefits[e,f,g]	**$4.50 ($2.73 - $6.27)**	**$4.14 ($2.64 - $5.65)**	**$4.14 ($2.64 - $5.65)**	**$4.50 (2.73 - $6.27)**	**$7.65 ($4.88 - $10.42)**	**$8.01 ($4.97 - $11.04)**
Visibility[h]						
Total Visibility Benefits - PM emissions	**$0.11 - $5.78**	**$0.10 - $4.43**	**$0.10 - $4.43**	**$0.11 - $5.88**	**$0.19 - $8.03**	**$0.20 - $9.44**
Total Annual Monetary Benefits[f]	**$2.84 - $12.05**	**$2.74 - $10.08**	**$2.74 - $10.08**	**$2.84 - $12.15**	**$5.07 - $18.45**	**$5.17 - $20.48**

Exhibit 8

MONETIZED NON-DISCOUNTED VALUE OF BENEFITS ASSOCIATED WITH THE PROPOSED HWC MACT REPLACEMENT STANDARDS (2002 Dollars in Millions)[a]

Notes:

a. Benefits associated with avoided mortality are presented in 1999 dollars and benefits associated with avoided morbidity are presented in 2002 dollars.

b. To avoid potential double counting with benefits related to minor restricted activity days, we do not provide monetized estimates associated with restricted activity days.

c. Monetized benefits associated with avoided premature mortality reflect a VSL range of $1.0 million to $10.0 million, with a central VSL estimate of $5.5 million. These values are consistent with those presented in U.S. EPA, *Benefits of the Proposed Inter-State Air Quality Rule*, January 2004. However, these VSL values are in 1999 dollars and are therefore inconsistent with morbidity and cost estimates, which are presented in 2002 dollars.

d. The primary estimate of dioxin benefits presented here reflects EPA's current guidance on the cancer risk (1.5×10^5 [mg/kg/day]-^{1}) associated with dioxin/furans. These values reflect a VSL range of $1.0 million to $10.0 million. As discussed in the text above, the Agency has been conducting a reassessment of the human health risks associated with dioxin and dioxin-like compounds. This reassessment will soon be under review at the National Academy of Sciences (NAS), as specified by Congress in the Conference Report accompanying EPA's fiscal year 2003 appropriation (Title IV of Division K of the Conference Report for the Consolidated Appropriations Resolution of 2003). Evidence compiled from this draft reassessment indicates that the carcinogenic effects of dioxin/furans may be as much as six times as great as believed in 1985, reflecting an upper bound cancer risk slope factor of 1×10^6 [mg/kg/day]$^{-1}$ for some individuals. Use of the alternative upper bound cancer risk slope factor would result in up to 0.35 premature cancer deaths avoided in response to the proposed replacement standards for dioxin/furans. The assessment of upper bound cancer risk using this alternative slope factor should not be considered Agency policy.

e. This estimate differs from benefits associated with the standards presented in the 2004 *Assessment* in that it does not include benefits associated with beyond-the-floor chlorine standards for solid-fuel boilers or LWAKs. As explained in Appendix A of this Addendum, the solid fuel boiler beyond-the-floor standard for chlorine analyzed in the 2004 *Assessment* (110 ppmv) would have reduced emissions of SO_2, a PM precursor, by approximately 22,000 tons per year. Adapting from benefits estimates presented in U.S. EPA, 2003 *Technical Addendum: Methodologies for the Benefit Analysis of the Clear Skies Act of 2003*, September 2003 and U.S. EPA, *Benefits of the Proposed Inter-State Air Quality Rule*, January 2004, we estimate that the benefits associated with the solid fuel boiler beyond-the-floor standard for chlorine would yield annual health benefits of approximately $288.5 million (in 2002 dollars) under the Agency Preferred Approach

f. Totals may not add due to rounding.

g. Because of the uncertainty associated with the "high cancer risk" estimate of dioxin benefits, this estimate is not included in the total benefits estimates presented in this exhibit.

h. This estimate differs from benefits associated with the standards presented in the 2004 *Assessment* in that it does not include benefits associated with beyond-the-floor chlorine standards for solid-fuel boilers or LWAKs (see note b). As illustrated in Appendix B of this Addendum, the benefits associated with the solid fuel boiler beyond-the-floor standard for chlorine analyzed in the 2004 *Assessment* could yield annual visibility benefits of approximately $6.06 million (in 2002 dollars) under the Agency Preferred Approach.

In addition to benefits resulting from reduced PM emissions, the 2004 *Assessment* also provided general estimates of the health benefits associated with reduced metals emissions. The Addendum to the 1999 *Assessment* estimated that the reduction in lead emissions associated with the 1999 standards would reduce lead exposure below levels of concern (i.e., a blood level of at least 10 μg/dl) for seven children annually. However, the relatively modest reduction in lead emissions expected under the proposed HWC MACT replacement standards suggests that the replacement standards will reduce lead exposure below levels of concern for fewer than seven children annually.

Under the revised PM replacement standards, we estimate annual visibility benefits associated with the Agency Preferred Approach ranging from $106,300 to $5.78 million. The low end of this range, which is approximately 0.5 percent greater than the low-end estimate in the 2004 *Assessment*, assumes a linear relationship between health benefits and visibility benefits. In contrast, the higher of the two estimates assumes a linear relationship between PM emissions reductions and visibility improvements and is approximately 22 percent lower than the high-end estimate presented in the 2004 *Assessment*. Across other regulatory options, the lower estimate ranges from $104,600 to $195,500 per year, which represents a 0.3 to 4.9 percent decline compared to the low-end estimates presented in the 2004 *Assessment*. Varying between $4.43 and $9.44 million annually, the high-end estimates for these options are approximately 25 percent less than the corresponding results in the 2004 *Assessment*. Similar to the current estimates of health benefits, changes in the low-end and high-end visibility estimates reflect less stringent PM standards and an adjustment to the inflation factor applied in the analysis. Both estimates are based on results presented in *The Benefits and Costs of the Clean Air Act 1990 to 2010*.[19] Chapter 6 of the 2004 *Assessment* contains additional information on the methodologies associated with both estimates.

The annual emissions reductions achieved under the HWC MACT replacement standards may not have an immediate impact on public health. Specifically, avoided mortalities resulting from annual reductions in PM and dioxin/furans emissions may occur over a period of several years. For example, the epidemiological literature suggests that premature mortality associated with dioxin/furans emissions may not occur until 21 to 34 years following exposure.[20] Similarly, the premature mortalities resulting from PM emissions may be distributed over the five years subsequent to exposure.[21] Since a portion of the benefits associated with the proposed HWC MACT replacement standards may materialize over a period of several years, we estimated discounted benefits as a sensitivity analysis. The results of this analysis are presented in Exhibit 9. For comparison, Exhibit 9 also includes non-discounted benefits.

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[19] U.S. EPA, *The Benefits and Costs of the Clean Air Act 1990 to 2010*, November 1999.

[20] Jim Neumann and Bob Unsworth, Addenda to Mortality Valuation Methodology, internal memorandum submitted to Jim DeMocker, September 28, 1993.

[21] U.S. EPA, 2003 *Technical Addendum: Methodologies for the Benefit Analysis of the Clear Skies Act of 2003*, September 2003

Exhibit 9

Comparison of Discounted And Non-discounted Benefits of the Hazardous Waste Combustion MACT Replacement Standards

Benefit Category and Pollutant	***Monetized Value***[a,b] *(million 2002 dollars per year)*		
	Non-discounted	*Three Percent Discount Rate*	*Seven Percent Discount Rate*
Human Health Benefits			
Dioxin/Furans[c]:			
Baseline to Floor -	$0.03	$0.01 - $0.02	$0.003 - $0.01
Floor to Beyond-the-Floor -	$0.29	$0.11 - $0.16	$0.03 - $0.07
Baseline to Beyond-the-Floor:	$0.32	$0.12 - $0.17	$0.03 - $0.08
Particulate Matter[d]:			
Mortality -	$1.84	$1.70	$1.54
Morbidity -	$2.34	$2.34	$2.34
Baseline to Beyond-the-Floor:	$4.18	$4.04	$3.87
TCl[e]:	*Not monetized*	*Not monetized*	*Not monetized*
Mercury:	*Not monetized*	*Not monetized*	*Not monetized*
Lead:	*Not monetized*	*Not monetized*	*Not monetized*
Human Health Sub Total:[f]	**$4.50**	**$4.15 - $4.21**	**$3.91 - $3.95**
Visibility Benefits:			
Visibility Sub-total Particulate Matter:	**$0.11 - $5.78**	**$0.11 - $5.78**	**$0.11 - $5.78**
Grand Total [f]	***$4.61 - $10.28***	***$4.26 - $9.99***	***$4.02 - $9.73***

Exhibit 9

Comparison of Discounted And Non-discounted Benefits of the Hazardous Waste Combustion MACT Replacement Standards

Notes:

a. Estimates of monetized benefits presented in this exhibit reflect a central VSL estimate of $5.5 million. This value reflects the mean of the estimated VSL 95 percent confidence interval estimated for U.S. EPA, *Benefits of the Proposed Inter-State Air Quality Rule*, January 2004. In contrast, estimates in Exhibit 8 reflect this central value and the $1 million to $10 million range.
b. Benefits associated with avoided mortality are expressed in 1999 dollars, unlike compliance costs and benefits associated with reduced morbidity, which are expressed in 2002 dollars. Since a portion of benefits are in 1999 dollars instead of 2002 dollars, the estimate of total benefits presented here is not comparable with cost estimates.
c. Total dioxin/furans emissions reductions are 4.68 grams per year, represented by 0.42 grams interim baseline to floor and 4.26 grams floor to BTF. The range of monetized benefits reflects a latency period ranging from 21 years to 34 years. In addition, this range reflects a cancer risk factor of 1.5×10^5 $[mg/kg/day]^{-1}$. As discussed in the text above, the Agency has been conducting a reassessment of the human health risks associated with dioxin and dioxin-like compounds. This reassessment will soon be under review at the National Academy of Sciences (NAS), as specified by Congress in the Conference Report accompanying EPA's fiscal year 2003 appropriation (Title IV of Division K of the Conference Report for the Consolidated Appropriations Resolution of 2003). Evidence compiled from this draft reassessment indicates that the carcinogenic effects of dioxin/furans may be as much as six times as great as believed in 1985, reflecting an upper bound cancer risk slope factor of 1×10^6 $[mg/kg/day]^{-1}$ for some individuals. Use of the alternative upper bound cancer risk slope factor would result in up to 0.35 premature cancer deaths avoided in response to the proposed replacement standards for dioxin/furans. The assessment of upper bound cancer risk using this alternative slope factor should not be considered Agency policy.
d. Monetized PM mortality benefits assume that 25 percent of premature mortalities occur during the first year, 25 percent occur during the second year, and 16.7 percent occur in each of the three subsequent years after exposure. We assume no time lag is associated with PM morbidity effects. This methodology is consistent with EPA's analysis of the proposed Clear Skies Act of 2003. EPA, *Technical Addendum: Methodologies for the Benefit Analysis of the Clear Skies Act of 2003*, September 2003.
e. The beyond-the-floor version of the chlorine standards analyzed in the 2004 *Assessment* would yield ancillary benefits associated with reduced emissions of SO_2. These benefits are not presented in the 2004 *Assessment*, but Appendix A to this Addendum presents information on these benefits.
f. Totals may not add due to rounding. Totals do not include dioxin benefits associated with the high-end dioxin toxicity estimate.

As Exhibit 9 shows, monetized benefits of the proposed HWC MACT replacement standards range from $4.02 million to $10.28 million, depending on which discount rate is used. For example, the high-end estimate of total non-discounted benefits is $10.28 million, whereas our high-end estimates discounted at 3 percent and 7 percent are $9.99 million and $9.73 million respectively. Although our estimates of total benefits are sensitive to discounting assumptions, discounting has no effect on our estimates of morbidity and visibility benefits because we assume that there is no latency associated with these benefits.

It is important to emphasize that the monetized benefits presented in this Addendum represent only a portion of the benefits associated with the proposed replacement standards. Specifically, ecological benefits and health benefits associated with reduced emissions of chlorine, mercury, lead, and several other hazardous air pollutants are not monetized.

EQUITY CONSIDERATIONS AND OTHER IMPACTS

Changes to the PM replacement standards and design levels have no impact on most of the equity considerations and other regulatory concerns addressed under relevant Executive Orders. The costs associated with the proposed PM replacement standards under the Agency Preferred Approach range from \$55.6 to \$82.8 million. Since these costs total less than \$100 million, the proposed replacement standards do not represent a significant unfunded mandate and are consequently exempt from requirements associated with the Unfunded Mandates Reform Act. Because the changes to the proposed standards do not reflect changes in locations or operating status of regulated facilities, the proposed replacement standards may still result in significant health and environmental benefits to minority and low-income populations living in proximity to hazardous waste combustion facilities. For the same reasons described in the 2004 *Assessment*, the proposed PM replacement standards will not be likely to have a significant joint impact on the actions of facilities controlled by other regulations. Likewise, the revised replacement standards do not have implications as defined in Executive Order 13175, "Consultation With Indian Tribal Governments;" Executive Order 13132, "Federalism;" and Executive Order 12630, "Government Actions and Interference with Constitutionally Protected Property Rights." The remainder of this section discusses the impacts of the proposed PM replacement standards on small entities, children's health protection, and energy use, as well as non-air environmental impacts.

<u>Assessment of Small Entity Impacts</u>

According to the Small Business Administration, the same six facilities as those identified in the 2004 *Assessment* are small businesses. The total compliance costs per facility, however, vary due to the proposed PM replacement standards.[22] As Exhibit 10 demonstrates, under the revised replacement standards, estimated costs decline for most facilities classified as small businesses. Costs at the one facility where compliance costs exceed 1 percent of total annual sales increase marginally from 2.21 percent of annual sales to 2.23 percent.[23] Under the market-adjusted scenario, we expect that this facility will continue to operate. Therefore, the new proposed PM replacement standards are not likely to result in a significant economic impact on a substantial number of small hazardous waste combustion facilities.

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[22] Total compliance costs represent engineering costs, the upper-bound estimate of costs. This conservative approach generally overestimates compliance costs as a percentage of total sales.

[23] This estimate does not reflect the elimination of the beyond-the-floor chlorine standards for LWAKs under the Agency Preferred Approach. This facility's compliance costs as a percent of total sales are likely to be lower than estimated in this Addendum.

Exhibit 10

SMALL ENTITY ANALYSIS RESULTS

Facility Name/ Parent Company[a]	EPA ID	Combustor Type	Corporate Entity Annual Sales (dollars)[b]	Total Compliance Costs in the 2004 *Assessment* (Agency Preferred Approach)[c] (dollars)	Revised Total Compliance Costs (Agency Preferred Approach)[d] (dollars)	Revised Costs As a Percentage of Sales (CPS)
Reilly Industries, Inc.	IND000807107	Liquid Boiler	$329,600,000	$715,900	$704,600	0.21%
Rubicon, Inc.	LAD008213191	Liquid Boiler	$465,000,000	$848,800	$844,800	0.18%
Continental Cement Company	MOD054018288	Cement Kiln	$52,400,000	$238,900	$87,300	0.17%
Thermalkem (Norlite); subsidiary of United Oil Recovery	NYD080469935	LWAK	$49,100,000	$1,077,600	$1,092,500[e]	2.23%
3V, Inc. [f]	SCD980500052	Liquid Boiler	$62,600,000	$45,100	$44,100	0.07%
Velsicol Chemical Corporation	TND007024664	On-Site Incinerator	$150,000,000	$5,200	$6,800	<0.01%

Exhibit 10

SMALL ENTITY ANALYSIS RESULTS

Notes:
[a] Except in the case of Norlite, the name of each facility's parent company is the same as the name of the facility itself.
[b] Corporate entity data obtained from ReferenceUSA, Dun and Bradstreet, company websites, and company financial documents.
[c] Total compliance costs represent the upper-bound engineering costs under the proposed HWC MACT replacement standards described in the 2004 *Assessment*, assuming facilities upgrade to comply with proposed standards.
[d] Revised total compliance costs represent the upper-bound engineering costs under the proposed PM replacement standards, assuming facilities upgrade to comply with proposed standards.
[e] Estimated compliance costs for this facility do not reflect the elimination of the beyond-the-floor chlorine controls for LWAKs. The compliance cost value presented here for this facility may overestimate the facility's actual compliance costs under the Agency Preferred Approach.
[f] 3V, Incorporated is an Italian-owned company with facilities in the United States, Italy, and several other countries. Employment in the U.S. is at least 270 people, and overall employment worldwide is likely over 500 people (the small business size threshold). However, we included this facility as a small business because it is an internationally-owned company and we were unable to confirm total employment. Sales data are for the single facility in South Carolina.

Children's Health Protection Analysis

Most health benefits associated with the proposed replacement standards result from reduced PM emissions. The revision to the proposed PM replacement standards, however, does not change the number of avoided premature deaths and illnesses in children, relative to results presented in the 2004 *Assessment*. The standards should still prevent less than one premature death and approximately 54 illness cases per year. As described in the 2004 *Assessment*, separate results are not available for children. We assume, however, that children would experience significant health benefits since they are particularly vulnerable to the effects of PM exposure.[24] Benefits associated with mercury and lead controls will also remain the same since the mercury and lead standards have not changed.[25] If the Agency implements chlorine controls, the effect on children's health will be positive. We do not quantify the exact magnitude of these benefits given available data, but reduced chlorine emissions may prevent eye, nose, and respiratory tract irritations; pulmonary edema; gastritis; bronchitis; asthma and swelling of the lungs; headaches; heart disease; meningitis; and death. We assume that children would experience some of these health benefits as their exposure to chlorine declines.

Energy Impact Analysis

In order to comply with the proposed PM replacement standards, regulated hazardous waste combustion facilities may upgrade their pollution abatement systems, consolidate hazardous waste into fewer systems located on site, or stop burning hazardous waste. Under the market-adjusted scenario, we expect that hazardous waste combustion systems will comply as described in the 2004 *Assessment.* Of the 276 systems in the regulatory universe, 218 will upgrade, 45 will close and ship their waste off-site, and 13 will consolidate. Consequently, compared to results presented in the 2004 *Assessment*, energy use impacts are unchanged under the revised PM replacement standards. The standards will result in the use of an additional 1,0172,722 million Btus of energy per year, costing at least $1,377,396. This increase represents less than 0.0032 percent of the energy consumed in 2002, and consequently, the rule does not represent a "significant energy action" as defined in Executive Order 12311, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use." As in the 2004 *Assessment*, these estimates do not include energy and costs associated with system upgrades and thus underestimate the total energy impact of the proposed PM replacement standards.

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[24] U.S. EPA, *Environmental Health Threats to Children*, EPA 175-F-96-001, September 1996, 4.

[25] Note that lead-related benefits, while modest, may be higher than those reported in the 2004 *Assessment*. These benefits are expected to be less than the seven cases estimated in the July 23, 1999 Addendum and under the 2002 Interim Standards.

<u>Non-air Environmental Impacts</u>

Most of our estimates of the non-air environmental impacts associated with the revised standards are similar to those presented in the 2004 *Assessment*. Differences between current and previous estimates reflect changes in the standards and slight modifications to the technologies we assume different systems will implement to comply with the standards.

The Agency now estimates that systems using wet scrubbers to control chlorine emissions will generate an additional 4.6 billion gallons of wastewater per year, compared to the 4.0 billion gallons estimated in the *Assessment*. In addition, we estimate that systems installing dry scrubbers to limit chlorine emissions will generate approximately 33,000 tons of spent sorbent per year, just 1,000 tons less than estimated in the 2004 *Assessment*. We also project that facilities using activated carbon to control emissions of dioxins/furans and mercury will generate approximately 8,000 tons of carbon on an annual basis, which represents a 3,000 ton reduction relative to the estimate presented in the 2004 *Assessment*. Controls for other pollutants will likely increase annual water consumption by 500 million gallons and generate an additional 5,000 tons of solid waste per year. The former estimate is 50 percent less than the corresponding estimate presented in the 2004 *Assessment*.

COST EFFECTIVENESS ANALYSIS

The revised proposal for the HWC MACT replacement standards does not significantly change most of the cost-effectiveness estimates reported in the 2004 *Assessment*. Exhibits 11 and 12 present the updated cost-effectiveness results. These exhibits do not present separate estimates for versions of the standards that exclude controls on chlorine emissions. With the exception of estimates associated with chlorine, the cost-effectiveness for such versions of the standards are the same as the corresponding versions of the replacement standards that include chlorine controls. Key findings from these updated results include the following:

- Cost-effectiveness per ton of reduced PM emissions from LWAKs and incinerators are not calculated because the revised standards do not require PM controls at these systems.

- The LWAK and coal boiler chlorine standards under the Agency Preferred Approach are now more cost effective than the corresponding standards presented in the 2004 *Assessment*. This change reflects the elimination of beyond-the-floor chlorine standards for these sources.

- Across all source categories, cost-effectiveness estimates associated with SVM and LVM have changed relative to the estimates reported in the 2004

Assessment. These changes are consistent with the revised PM standards since emissions of SVM and LVM are influenced by controls on PM.

- Per unit health improvement, the revised proposal for the HWC MACT PM replacement standards is more cost-effective than the previous proposal. Under the Agency Preferred Approach, the cost-effectiveness of the revised PM standards is approximately $47.9 million per life saved and $2,617 per avoided morbidity case, both of which represent an 18 percent improvement compared to the corresponding estimates of $58.4 million per life saved and $3,187 per avoided illness presented in the 2004 *Assessment*. These revised estimates reveal that the revised PM standards are more cost-effective than the previous standards because estimated reductions in premature death and morbidity have changed little from estimates presented in the 2004 *Assessment*, while estimated engineering costs have fallen.

Exhibit 11

COST-EFFECTIVENESS RESULTS[a]

		Pollutant					
Source	**Options**	**TEQ, $1,000/ gram**	**Hg, $1,000/ ton**	**SVM, $1,000/ ton**	**LVM, $1,000/ ton**	**PM, $1,000/ ton**	**TCl, $1,000/ ton**
LWAKs	Baseline to Floor Option 1	-	$120,054	$1,861	$6,283	-	-
	Baseline to Agency Preferred Approach	$915	$120,054	$1,861	$6,283	-	$6.82
	Option 1 Floor to Agency Preferred Approach	$915	-	-	-	-	$6.82
	Baseline to Floor Option 2	-	$119,961	$1,794	$5,172	-	-
	Baseline to Option 2 BTF-D	$724	$119,961	$1,794	$5,172	-	$6.59
	Option 2 Floor to Option 2 BTF-D	$724	-	-	-	-	$6.59
	Baseline to Floor Option 3	-	$119,960	$2,985	$8,127	-	-
	Baseline to Option 3 BTF-D	$767	$119,960	$2,985	$8,127	-	$5.45
	Option 3 Floor to Option 3 BTF-D	$767	-	-	-	-	$5.45
Incinerators	Baseline to Floor Option 1	$2,627	-	$2,965	$3,607	-	$44.34
	Baseline to Agency Preferred Approach	$2,627	-	$2,965	$3,607	-	$44.34
	Option 1 Floor to Agency Preferred Approach	-	-	-	-	-	-

Exhibit 11

COST-EFFECTIVENESS RESULTS[a]

Source	Options	TEQ, $1,000/ gram	Hg, $1,000/ ton	SVM, $1,000/ ton	LVM, $1,000/ ton	PM, $1,000/ ton	TCl, $1,000/ ton
	Baseline to Floor Option 2	$2,627	-	$4,402	$7,724	-	$39.38
	Baseline to Option 2 BTF-D	$2,627	-	$4,402	$7,724	-	$39.38
	Option 2 Floor to Option 2 BTF-D	-	-	-	-	-	-
	Baseline to Floor Option 3	$2,627	-	$4,339	$6,806	-	$38.74
	Baseline to Option 3 BTF-D	$2,627	-	$4,339	$6,806	-	$38.74
	Option 3 Floor to Option 3 BTF-D	-	-	-	-	-	-
Cement Kilns	Baseline to Floor Option 1	-	$16,567	$405	$10,458	$13.17	$8.62
	Baseline to Agency Preferred Approach	-	$16,567	$405	$10,458	$13.17	$8.62
	Option 1 Floor to Agency Preferred Approach	-	-	-	-	-	-
	Baseline to Floor Option 2	-	$22,501	$1,319	$20,535	$13.95	$13.14
	Baseline to Option 2 BTF-D	-	$22,501	$1,319	$20,535	$13.95	$13.14
	Option 2 Floor to Option 2 BTF-D	-	-	-	-	-	-
	Baseline to Floor Option 3	-	$22,501	$1,489	$13,189	$7.85	$13.14
	Baseline to Option 3 BTF-D	-	$22,501	$1,489	$13,189	$7.85	$13.14
	Option 3 Floor to Option 3 BTF-D	-	-	-	-	-	-
Liquid Boilers	Baseline to Floor Option 1	$373	$13,072	$4,172	$733	$9.67	$6.40
	Baseline to Agency Preferred Approach	$662	$13,072	$4,172	$733	$9.67	$6.40
	Option 1 Floor to Agency Preferred Approach	$1,313	-	-	-	-	-
	Baseline to Floor Option 2	$373	$14,191	$4,161	$738	$9.39	$13.52
	Baseline to Option 2 BTF-D	$662	$14,191	$4,161	$738	$9.39	$13.52
	Option 2 Floor to Option 2 BTF-D	$1,916	-	-	-	-	-
	Baseline to Floor Option 3	$373	$17,209	$1,215	$262	$9.60	$6.51
	Baseline to Option 3 BTF-D	$662	$17,209	$1,215	$262	$9.60	$6.51

Exhibit 11

COST-EFFECTIVENESS RESULTS[a]

		Pollutant					
Source	**Options**	**TEQ, $1,000/ gram**	**Hg, $1,000/ ton**	**SVM, $1,000/ ton**	**LVM, $1,000/ ton**	**PM, $1,000/ ton**	**TCl, $1,000/ ton**
	Option 3 Floor to Option 3 BTF-D	$1,313	-	-	-	-	-
Coal Boilers	Baseline to Floor Option 1	-	$23,274	$687	$343	$4.68	$1.16
	Baseline to Agency Preferred Approach	-	$23,274	$687[b]	$343[b]	$3.32	$1.16[c]
	Option 1 Floor to Agency Preferred Approach	-	-	-	-	$3.97	-[c]
	Baseline to Floor Option 2	-	$23,274	$687	$343	$4.68	$1.16
	Baseline to Option 2 BTF-D	-	$23,274	$687[b]	$343[b]	$3.76	$1.16
	Option 2 Floor to Option 2 BTF-D	-	-	-	-	$3.69	-
	Baseline to Floor Option 3	-	$23,274	$683	$339	$4.43	$1.16
	Baseline to Option 3 BTF-D	-	$23,274	$683[b]	$339[b]	$3.21	$1.16
	Option 3 Floor to Option 3 BTF-D	-	-	-	-	$3.82	-
HCl Production Furnaces	Baseline to Floor Option 1	-	-	-	-	-	$4.99
	Baseline to Agency Preferred Approach	$823	-	-	-	-	$4.99
	Option 1 Floor to Agency Preferred Approach	$823	-	-	-	-	-
	Baseline to Floor Option 2	-	-	-	-	-	$7.32
	Baseline to Option 2 BTF-D	$698	-	-	-	-	$7.32
	Option 2 Floor to Option 2 BTF-D	$698	-	-	-	-	-
	Baseline to Floor Option 3	-	-	-	-	-	$7.21
	Baseline to Option 3 BTF-D	$987	-	-	-	-	$7.21
	Option 3 Floor to Option 3 BTF-D	$987	-	-	-	-	-

Exhibit 11

COST-EFFECTIVENESS RESULTS[a]

		Pollutant					
Source	**Options**	**TEQ, $1,000/ gram**	**Hg, $1,000/ ton**	**SVM, $1,000/ ton**	**LVM, $1,000/ ton**	**PM, $1,000/ ton**	**TCl, $1,000/ ton**

Notes:

a. This table includes pollutants where more than one option was under consideration.

b. Despite higher SVM and LVM emission reductions under the beyond-the-floor option, cost effectiveness for coal boiler SVM and LVM under the beyond-the-floor option are equal to cost effectiveness estimates under the corresponding Floor. Since the incremental reductions under the beyond-the-floor option are due to tighter PM restrictions, we do not incorporate them into our estimate of the cost effectiveness of beyond-the-floor SVM and LVM standards.

c. The chlorine standards under the Agency Preferred Approach evaluated in the 2004 *Assessment* included a beyond-the-floor standard for coal boilers. The cost-effectiveness of this beyond-the-floor standard, incremental to the floor standard, was $473,000 per ton. Incremental to the baseline, the cost-effectiveness of the standard was $349,000 per ton.

Exhibit 12

COST-EFFECTIVENESS PER UNIT HEALTH IMPROVEMENT[a,b,c,d]
(using unadjusted, maximum cost of control, 2002$)

Benefit Type	Pollutant(s)	Option 1 Floor	Agency Preferred Approach	Option 2 Floor	Option 2 BTF-D	Option 3 Floor	Option 3 BTF-D
Health Benefits							
Avoided Premature Mortality Cases [e]	PM	$42.6 million per life saved	$47.9 million per life saved	$41.5 million per life saved	$46.9 million per life saved	$38.0 million per life saved	$40.6 million per life saved
Avoided Premature Mortality Cases	Dioxins/Furans	$159.5 million per life saved	$85.9 million per life saved	$159.5 million per life saved	$81.0 million per life saved	$159.5 million per life saved	$92.4 million per life saved
Avoided Morbidity (PM)[f]	PM	$2,361 per case	$2,617 per case	$2,303 per case	$2,560 per case	$2,273 per case	$2,412 per case
Avoided Morbidity (lead)[g]	SVM	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Ecological Benefits							
Reduction in area of Land and Water Impacted	dioxin, mercury, lead	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

Notes:
[a] Engineering costs.
[b] Dollar per unit benefit.
[c] These cost-effectiveness per unit benefit measures are upper bound estimates that apply the full costs of control (by pollutant) to a single type of benefit (e.g., lives saved). The cost per unit benefit measures should not be reported in isolation from other benefit estimates; they should only be used as relative measures to compare across MACT standards.
[d] All figures are incremental from the baseline to the HWC MACT standards.
[e] Mortality cases comprise fatal cancers and fatalities from exposure to particulate matter.
[f] PM morbidity cases comprise hospital admissions from respiratory diseases, cases of chronic bronchitis and asthma, work loss days, and mild restricted activity days.
[g] SO_2 morbidity cases comprise reduced incidence of chronic bronchitis, acute bronchitis, non-fatal myocardial infarctions, hospital admissions (respiratory and cardiological), emergency room visits, respiratory symptoms,
[g] Morbidity cases associated with exposure to lead are cases in which children have blood lead levels above 10µg/dL.

Appendix A

Hazardous Waste Combustion MACT Replacement Standards: Proposed Rule

Assessment of Benefits

Associated with the

Beyond-the-Floor Standard for TCl from Solid Fuel Boilers Burning Hazardous Waste

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We have identified expected reductions in sulfur dioxide (SO_2) emissions from coal fired boilers that may occur under one option considered for the Hazardous Waste Combustion (HWC) MACT replacement standards. This option would require coal-fired (i.e., solid fuel) hazardous waste burning boilers and LWAKs to meet a beyond-the-floor standard for chlorine. Under this option, facilities with coal-fired hazardous waste burning boilers would need to install flue gas desulfurization (i.e., "dry scrubber") technology[26] In addition to controlling releases of chlorine, dry scrubbers will reduce emissions of sulfur dioxide from these facilities.

This Assessment examines anticipated benefits associated with SO_2 emissions reductions. To develop a range of potential benefits estimates of SO_2 reductions, we adjusted published national estimates of SO_2 control benefits to reflect our estimate of the total SO_2 emissions (tons/year) avoided in response to the beyond-the-floor (BTF) standard for chlorine in solid fuel boilers. We first provide two estimates of benefits based on extrapolation from available literature. We then incorporate a number of very conservative assumptions to provide a "lower bound" estimate of benefits. Finally, we discuss the primary limitations associated with our analysis.

Sulfur Dioxide Emission Reductions

Four facilities in the HWC MACT regulated universe have solid fuel boilers. These facilities are: 1) Eastman Chemical Company in Tennessee (seven boilers), 2) Union Carbide in West Virginia (one boiler), 3) Celanese Chemicals in Texas (two boilers), and, 4) Eastman Chemical Company facility in Arkansas (two boilers). None of the boilers at these facilities are currently equipped with dry scrubbers.

We estimate baseline (SO_2) emissions from these facilities at 37,000 tons per year, reflecting operating requirements under test conditions. The Texas and Arkansas facilities are assumed to use low sulfur coal (sulfur content of 0.6 percent), and the West Virginia and Tennessee facilities are believed to use eastern coal (sulfur content ranging from one to five percent, with an average value of 2.5 percent).

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[26] The specific technology is simple direct duct injection dry scrubbing. EPA Floor option regulatory scenarios (i.e., Floor Option 1, Floor Option 2, and Floor Option 3) would not require dry scrubbers and would therefore incur no benefits associated with SO_2 reductions.

Our engineers have determined that the installation of dry scrubbers for required control of HCl (beyond-the-floor standard) will reduce SO_2 emissions by 60 percent, or 22,000 tons per year. Exhibit 1 summarizes the SO_2 emissions reductions.

Exhibit 1

SUMMARY OF ESTIMATED SO_2 EMISSION REDUCTIONS

Beyond-the-Floor Standard for TCl - Solid Fuel Boilers

Facility	Sulfur Content of Coal	Baseline SO_2 Emissions	*SO_2 Emission Reductions*	SO_2 Emissions Under TCl BTF Option
Eastman Chemical Co., Kingsport, Tennessee	2.5%	26,130	*15,680*	10,450
Celanese Chemicals, Pampa, Texas	0.6%	6,280	*3,770*	2,510
Union Carbide, South Charleston, West Virginia	2.5%	4,000	*2,400*	1,600
Eastman Chemical Co., Batesville, Arkansas	0.6%	550	*330*	220
TOTAL		**36,960**	***22,180***	**14,780**

Evaluation of Benefits

To develop initial estimates of potential benefits associated with SO_2 emissions reductions, we scale existing published national benefits assessments associated with SO_2 emissions reductions under the Clear Skies Initiative and the Inter-State Air Quality Rule (IAQR).[27] As detailed in these documents and other literature, a significant percentage of the benefits associated with the control of SO_2 results from avoided health effects associated with the development of fine particulate matter (PM) formed by SO_2 in the atmosphere. The Clear Skies Initiative and the IAQR both examine benefits associated with reduction in PM resulting from both SO_2 and nitrogen (NOx) releases.

Our preliminary benefit estimate assumes a linear relationship between quantity of sulfur dioxide controlled and monetary benefits. In addition, we assume:

- The facilities in the HWC MACT universe are similar to the national average addressed in the Clear Skies and IAQR analyses in terms of affected populations and avoided health impacts.
- The relationship between benefits and quantity of SO_2 emissions reduced is linear even at relatively small quantities (i.e., 22,000 tons).
- Where benefits related to particulate matter associated with SO_2 emissions reductions and NOx reductions are not reported separately, the relationship between benefits is proportional to the quantity of pollutants (i.e., if SO_2 emissions represent 50 percent of the per weight pollutant reductions, then they

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27 U.S. EPA, 2003, *Technical Addendum: Methodologies for the Benefit Analysis of the Clear Skies Act of 2003*, accessed February 17, 2004, at <http://www.epa.gov/clearskies/ tech_addendum.pdf>; U.S. EPA, 2003, *Technical Support Document for the Clear Skies Act 2003 Air Quality Modeling Analysis*, accessed February 17, 2002, at <http://www.epa.gov/air/clearskies/ aq_modeling_tsd_csa2003.pdf>; U.S. EPA, *Benefits of the Proposed Inter-State Air Quality Rule*, accessed February 17, 2004, at <http://www.epa.gov/interstateairquality/tsd0175.pdf>. In addition, we examined an unpublished draft report by Carrothers et al. (2002), which estimates national exposure to PM 2.5 and gaseous precursors from coal-fired power plants and mobile sources. The report then estimates benefits associated with reduced mortality due to decreases in emissions. Carrothers, Timothy J., Scott K. Wolff, Jouni Tuomisto, Andrew M. Wilson, Jonathan I. Levy, John D. Graham, John D. Graham, John S. Evans, 2002, Assessing the Economic Value of Further Research about Fine Particle Air Pollution: Model Framework and Preliminary Findings, final review draft.

represent 50 percent of the benefits).[28]

The Clear Skies and IAQR analyses each predicted a total reduction in SO_2 emissions of roughly 3.5 million tons and NOx reductions of 1.5 million tons. The total benefits associated with particulate matter reductions were estimated at $51.5 to $109.3 billion (1999 dollars) in the Clear Skies analysis and $54.5 to $83.6 billion (1999 dollars) in the IAQR analysis.[29]

Assuming that SO_2 emissions reductions represent roughly 70 percent[30] of total particulate matter benefits, we estimate that a reduction of 22,000 tons of SO_2 emissions under the HWC MACT standards would incur total monetized benefits ranging from $212 million to $350 million per year. This result reflects a "dollar per ton" range of $9,700 to $15,900 for benefits per ton of SO_2 removed. If only mortality is included, annual monetized benefits would range from $193 million to $320 million, reflecting a "dollar per ton" range of approximately $8,800 to 14,600 for benefits per ton of SO_2 removed.

Exhibit 2 provides a more detailed summary of the range of potential benefits based on both studies.

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28 Note that this is a conservative assumption because in general, SO_2 is a more efficient precursor of particulate matter than nitrous oxides.

29 These estimates reflect the average of a range of discount rates and scenarios. Low end estimates reflect IAQR study near term benefits using a seven percent discount rate; High-end estimates reflect Clear Skies study longer term benefits using a three percent discount rate. The estimates also exclude ozone-related benefits; IAQR study estimated total benefits (including ozone-related benefits) at $54 to $84 billion; the Clear Skies study estimated total benefits (including ozone-related benefits) at $52 to $113 billion.

30 The Clear Skies and IAQR total predictions (SO_2 plus NO_x) of approximately 5.0 million tons/yr emissions reductions (3.5/5.0 = 70 percent).

Exhibit 2

SUMMARY OF BENEFITS ASSOCIATED WITH SO_2 EMISSION REDUCTIONS

Benefit Category	**IAQR Analysis** *(million 1999$)*	**Clear Skies Analysis** *(million 1999$)*
Total Mortality	50,000 - 72,000	47,000 - 100,000
Total Infant Mortality Benefits	130 - 180	–
Total Other Benefits	4,902 - 5,019	4,518 - 9,184
Total Benefits	54,532 - 83,599	51,518 - 109,284
Total SO_2 Benefits	39,911 - 57,812[a]	34,478 - 73,255[b]
Total Benefits of HWC MACT SO_2 Reductions: BTF Option (based on 22,000 tons/yr)[c]		
Total Benefits (millions)	$247.4 - $332.9	$212.4 - $350.0
Average of Total Benefits (millions)	$281.7	$281.9
Total Benefits, per Ton (dollars)	$10,642 - $15,133	$9,655 - $15,908
Average of Total Benefits, per Ton (dollars)	$12,808	$12,814
Mortality Benefits Only (millions)	$215.2 - $307.4	$193.8 - $320.3
Average of Mortality Benefits Only (millions)	$259.5	$257.7
Mortality Benefits Only, per Ton (dollars)	$9,783 - $13,971	$8,808 - $14,557
Average of Mortality Benefits Only, per Ton (dollars)	$11,797	$11,714

Notes:
[a] Based on 3.7 -3.8 million tons SO_2 avoided, adjusted to exclude 28-31% NOx contribution.
[b] Based on 3.6 -4.6 million tons SO_2 avoided, adjusted to exclude 33% NOx contribution.
[c] These ranges reflect the use of different discount rates, time frames, and assumptions about non-mortality benefits. Low end estimates reflect near term mortality benefits only, using a seven percent discount rate; high-end estimates reflect longer term total benefits using a three percent discount rate.

Lower Bound Estimate of Benefits

In addition to the estimates based on a simple extrapolation of Clear Skies and IAQR analyses, we have developed a conservative lower-bound estimate of potential benefits (mortality only) associated with SO_2 emissions reductions resulting from the BTF TCl level for solid fuel boilers. This estimate includes only emissions reductions from the Tennessee Eastman facility and makes the following conservative assumptions:

- The facility uses only coal with a low sulfur content of one percent (initial estimate is based on sulfur content of 2.5 percent);
- The facility operates boilers at 50 percent of the intensity reflected in the trial burn data (initial estimate assumes that boilers operate as continuous process equipment at 90 percent of annual trial burn capacity); and [31]
- The low-end benefit estimate of $8,808 per ton of SO_2 eliminated accurately reflects regional benefits in northeastern Tennessee.

The resulting reductions in SO_2 emissions from the facility are therefore 3,100 tons per year rather than 15,680 tons per year. Under these lower-bound assumptions, we estimate annual benefits of roughly $27 million associated with SO_2 emission reductions. This reflects only the Eastman Tennessee facility and does not consider any benefits associated with the remaining three facilities with coal-fired hazardous waste boilers.

31 Note that this assumption is very conservative and is designed solely to develop a lower bound estimate. Because boilers are designed to provide power for other facility processes, it would be unusual for them to operate at levels as low as 50 percent. In addition, trial burn data (collected as part of the RCRA permitting process) were used to identify total coal requirements for boilers. Trial burns are typically designed to reflect maximum hazardous waste combustion. Because SO_2 is associated with the supplemental fuel coal (and not with hazardous waste), it is possible that trial burn data may *understate* baseline SO_2 emissions if normal operations involve less hazardous waste and more coal.

Key Limitations:

This assessment incorporates various key assumptions and limitations. These include:

- the affected populations for each of the facilities of concern are assumed to be generally consistent with populations affected by facilities examined in the Clear Skies and IAQR analyses,

- The specific technology required to meet the TCl BTF standard is simple direct duct injection dry scrubbing. This technology is also expected to result in the SO_2 emission reductions. [Note: The EPA Floor option regulatory scenarios would not require dry scrubbers and would therefore incur no potential benefits associated with SO_2 reductions.

  the boiler operation and stack heights of the facilities of concern are generally representative of the boilers and stack heights at the facilities examined in the Clear Skies and IAQR analyses,

- the linear extrapolation of national-level SO_2 reduction benefits is reasonable for quantities of roughly 20,000 tons; and

- baseline emissions estimates used in this analysis reflect current emissions for each of the facilities of concern.

Appendix B

DETAILED COST MODEL RESULTS

NOTE: *After the cost model was run to generate the results presented in this Appendix, EPA eliminated beyond-the-floor chlorine standards for LWAKs and solid fuel boilers. The results presented in this Appendix do not reflect this change.*

This appendix contains model results for the twelve versions of the HWC MACT replacement standards analyzed in the *Addendum to the Assessment of the Potential Costs, Benefits, & Other Impacts of the Hazardous Waste Combustion MACT Replacement Standards: Proposed Rule*. Results associated with Option 1 BTF-D represent the costs and other impacts of the Agency Preferred Approach.[32] The results for all options reflect potential price increases for hazardous waste incineration services in response to the HWC MACT replacement standards, as well as the most recent estimates of waste quantities, government costs, and monitoring/performance testing costs. The results presented in this appendix assume that commercial kilns and incinerators charge the same premium for treating halogenated waste and that commercial facilities pass 100 percent of their compliance costs on to their customers. The total cost estimates presented in this appendix do not include government costs, which are presented separately for each regulatory option.

[32] See note above.

OPTION 1

Net Private Costs, by Unit Type: SDL Option 1

	SDL Option 1 Floor, w/ CI Controls	SDL Option 1 Floor, w/o CI Controls	SDL Option 1 BTF-D, w/ CI Controls	SDL Option 1 BTF-D, w/o CI Controls
Commercial Incinerators	-$10,632,036.21	-$7,044,493.23	-$11,388,208.31	-$7,408,633.54
Cement Kilns	-$2,688,983.11	-$721,165.72	-$5,387,442.55	-$2,023,205.48
LWAKs	-$93,980.33	$88,125.70	$3,329,093.48	$1,740,084.93
Onsite Incinerators	$9,141,869.51	$978,411.78	$9,143,982.97	$978,679.18
Phase 1 Subtotal	**-$4,273,130.15**	**-$6,699,121.48**	**-$4,302,574.41**	**-$6,713,074.92**
Pre-existing customers of commercial combustion facilities	**$10,562,921.73**	**$7,412,957.36**	**$14,187,412.95**	**$9,161,964.85**
Liquid Boilers	$36,710,295.36	$32,586,162.22	$36,846,275.87	$32,660,129.66
Coal Boilers	$1,511,207.10	$1,023,168.32	$5,023,990.34	$2,221,088.88
HCl Production Furnaces	$1,470,615.58	$1,470,615.58	$3,359,766.69	$3,359,766.69
Phase 2 Subtotal	**$39,692,118.04**	**$35,079,946.13**	**$45,230,032.90**	**$38,240,985.24**
Total	**$45,981,909.62**	**$35,793,782.01**	**$55,114,871.43**	**$40,689,875.16**

Upgrade Expenditures, by Unit Type: SDL Option 1				
	SDL Option 1 Floor, w/ Cl Controls	**SDL Option 1 Floor, w/o Cl Controls**	**SDL Option 1 BTF-D, w/ Cl Controls**	**SDL Option 1 BTF-D, w/o Cl Controls**
Commercial Incinerators	$3,165,323.58	$1,034,979.26	$3,165,323.58	$1,034,979.26
Cement Kilns	$6,489,684.46	$5,940,214.96	$6,489,421.16	$5,939,951.66
LWAKs	$541,887.94	$541,887.94	$4,166,642.46	$2,291,158.72
Onsite Incinerators	$9,038,854.68	$968,809.83	$9,038,854.68	$968,809.83
Phase 1 Subtotal	**$19,235,750.66**	**$8,485,891.98**	**$22,860,241.88**	**$10,234,899.47**
Liquid Boilers	$34,600,145.55	$30,819,781.39	$34,732,671.87	$30,892,336.96
Coal Boilers	$1,381,306.23	$893,522.89	$4,893,793.90	$2,091,300.82
HCl Production Furnaces	$1,470,615.58	$1,470,615.58	$3,359,766.69	$3,359,766.69
Phase 2 Subtotal	**$37,452,067.37**	**$33,183,919.87**	**$42,986,232.46**	**$36,343,404.48**
Total	**$56,687,818.03**	**$41,669,811.85**	**$65,846,474.34**	**$46,578,303.95**

Private Engineering Costs: SDL Option 1

	SDL Option 1 Floor, w/ Cl Controls	SDL Option 1 Floor, w/o Cl Controls	SDL Option 1 BTF-D, w/ Cl Controls	SDL Option 1 BTF-D, w/o Cl Controls
Commercial Incinerators	$3,653,499.14	$1,034,979.26	$3,653,499.14	$1,034,979.26
Cement Kilns	$6,489,684.46	$5,940,214.96	$6,489,421.16	$5,939,951.66
LWAKs	$541,887.94	$541,887.94	$4,166,642.46	$2,291,158.72
Onsite Incinerators	$12,807,392.58	$1,517,236.48	$12,807,392.58	$1,517,236.48
Phase 1 Subtotal	**$23,492,464.12**	**$9,034,318.63**	**$27,116,955.34**	**$10,783,326.12**
Liquid Boilers	$44,736,319.42	$40,304,055.83	$44,890,789.55	$40,376,611.41
Coal Boilers	$1,834,543.61	$1,346,760.27	$6,864,742.06	$2,641,019.14
HCl Production Furnaces	$1,470,615.58	$1,470,615.58	$3,359,766.69	$3,359,766.69
Phase 2 Subtotal	**$48,041,478.61**	**$43,121,431.68**	**$55,115,298.30**	**$46,377,397.24**
Total	**$71,533,942.73**	**$52,155,750.31**	**$82,232,253.65**	**$57,160,723.36**

Number of Closed Systems, by Unit Type: Option 1

	SDL Option 1 Floor, w/ Cl Controls	SDL Option 1 Floor, w/o Cl Controls	SDL Option 1 BTF-D, w/ Cl Controls	SDL Option 1 BTF-D, w/o Cl Controls	Baseline Total
Commercial Incinerators	2	0	2	0	15
Cement Kilns	0	0	0	0	26
LWAKs	0	0	0	0	7
Onsite Incinerators	32	29	32	29	92
Liquid Boilers	22	20	22	20	107
Coal Boilers	2	2	2	2	12
HCl Production Furnaces	0	0	0	0	17
Total	58	51	58	51	276

Quantity of Waste Sent Offsite or Rerouted (tons): Option 1

	SDL Option 1 Floor, w/ Cl Controls	SDL Option 1 Floor, w/o Cl Controls	SDL Option 1 BTF-D, w/ Cl Controls	SDL Option 1 BTF-D, w/o Cl Controls
To Commercial Incinerators	44,548	23,085	44,548	23,085
To Cement Kilns or LWAKs	9,041	7,698	9,041	7,698
Non-commercial Consolidation	67,266	56,732	67,266	56,732
Total	120,855	87,515	120,855	87,515

Available Capacity at Commercial Facilities: Option 1

		Commercial Incinerators	Cement Kilns/LWAKs
Pre-MACT Capacity (tons)		188,193.00	504,875.53
Post-MACT (tons)	SDL Option 1 Floor, w/ Cl controls	116,547.89	495,834.52
	SDL Option 1 Floor, w/o Cl controls	165,107.76	497,177.63
	SDL Option 1 BTF-D, w/ Cl controls	116,547.89	495,834.52
	SDL Option 1 BTF-D, w/o Cl controls	165,107.76	497,177.63

Government Costs: Option 1

	Annual Cost
SDL Option 1 Floor, w/ Cl controls	$447,479.75
SDL Option 1 Floor, w/o Cl controls	$455,470.46
SDL Option 1 BTF-D, w/ Cl controls	$447,479.75
SDL Option 1 BTF-D, w/o Cl controls	$455,470.46

Number of Jobs Lost and Gained, by Unit Type: Option 1

	SDL Option 1 Floor, w/ Cl controls		SDL Option 1 Floor, w/o Cl controls		SDL Option 1 BTF-D, w/ Cl controls		SDL Option 1 BTF-D, w/o Cl controls	
	Lost	*Gained*	*Lost*	*Gained*	*Lost*	*Gained*	*Lost*	*Gained*
Commercial Incinerators	47.8	13.6	0.0	5.3	47.8	13.6	0.0	5.3
Cement Kilns	0.0	32.9	0.0	30.1	0.0	32.9	0.0	30.1
LWAKs	0.0	3.5	0.0	3.5	0.0	29.1	0.0	14.8
Onsite Incinerators	237.2	39.4	215.4	5.2	237.2	39.4	215.4	5.2
Liquid Boilers	92.0	208.7	82.9	191.1	92.0	208.7	82.9	191.3
Coal Boilers	9.5	10.7	9.5	7.0	9.5	32.7	9.5	11.2
HCl Production Furnaces	0.0	11.7	0.0	11.7	0.0	23.8	0.0	23.8
APCD Industry	-	162.3	-	110.7	-	178.8	-	125.0
Total	**386.5**	**482.8**	**307.8**	**364.7**	**386.5**	**559.0**	**307.8**	**406.8**

Combustion Prices ($ per ton): SDL Option 1

Waste Form	Baseline Prices	SDL Option 1 Floor, w/ Cl Controls	SDL Option 1 Floor, w/o Cl Controls	SDL Option 1 BTF-D, w/ Cl Controls	SDL Option 1 BTF-D, w/o Cl Controls
Inorganic Liquid (Halogenated)	$1,080.54	$1,090.25	$1,087.36	$1,093.60	$1,088.97
Inorganic Liquid (Nonhalogenated)	$127.05	$128.19	$127.85	$128.59	$128.04
Inorganic Sludge (Nonhalogenated)	$560.14	$565.17	$563.68	$566.91	$564.51
Inorganic Solids (NonHal)	$557.14	$562.15	$560.66	$563.87	$561.49
Lab Packs	$2,820.00	$2,845.34	$2,837.80	$2,854.07	$2,842.01
Gases	$940.00	$948.45	$945.93	$951.36	$947.34
Organic Liquids (Halogenated)	$1,080.54	$1,090.25	$1,087.36	$1,093.60	$1,088.97
Organic Liquids (NonHal)	$127.05	$128.19	$127.85	$128.59	$128.04
Organic Sludges (Halogenated)	$1,010.14	$1,019.22	$1,016.52	$1,022.34	$1,018.02
Organic Sludges (NonHal)	$560.14	$565.17	$563.68	$566.91	$564.51
Organic Solids (Halogenated)	$1,067.14	$1,076.73	$1,073.88	$1,080.03	$1,075.47
Organic Solids (NonHal)	$557.14	$562.15	$560.66	$563.87	$561.49

Net Private Costs, by Unit Type: SDL Option 2				
	SDL Option 2 Floor, w/ Cl Controls	**SDL Option 2 Floor, w/o Cl Controls**	**SDL Option 2 BTF-D, w/ Cl Controls**	**SDL Option 2 BTF-D, w/o Cl Controls**
Commercial Incinerators	-$14,853,559.44	-$9,091,171.81	-$15,549,719.33	-$9,391,107.51
Cement Kilns	$30,109.86	$1,349,763.14	-$2,449,616.16	$154,312.84
LWAKs	-$1,102,743.58	-$362,052.10	$2,036,645.82	$1,007,040.17
Onsite Incinerators	$11,734,629.27	$3,394,237.55	$11,739,156.66	$3,395,574.68
Phase 1 Subtotal	**-$4,191,563.89**	**-$4,709,223.22**	**-$4,223,533.01**	**-$4,834,179.83**
Pre-existing customers of commercial combustion facilities	**$33,249,151.48**	**$20,442,700.24**	**$36,573,582.53**	**$21,877,957.21**
Liquid Boilers	$47,162,524.41	$33,242,337.01	$47,353,184.07	$33,415,151.29
Coal Boilers	$1,513,054.10	$1,024,229.18	$5,025,812.88	$2,222,124.15
HCl Production Furnaces	$1,842,814.77	$1,842,814.77	$3,444,134.59	$3,444,134.59
Phase 2 Subtotal	**$50,518,393.28**	**$36,109,380.95**	**$55,823,131.53**	**$39,081,410.03**
Total	**$79,575,980.86**	**$51,842,857.97**	**$88,173,181.05**	**$56,125,187.40**

Upgrade Expenditures, by Unit Type: SDL Option 2				
	SDL Option 2 Floor, w/ Cl Controls	**SDL Option 2 Floor, w/o Cl Controls**	**SDL Option 2 BTF-D, w/ Cl Controls**	**SDL Option 2 BTF-D, w/o Cl Controls**
Commercial Incinerators	$4,165,271.17	$2,037,899.93	$4,165,271.17	$2,037,899.93
Cement Kilns	$27,965,218.06	$17,693,435.65	$27,965,218.06	$17,693,435.65
LWAKs	$815,489.45	$815,489.45	$4,139,920.51	$2,264,436.78
Onsite Incinerators	$11,533,002.81	$3,307,188.20	$11,533,002.81	$3,307,188.20
Phase 1 Subtotal	**$44,478,981.49**	**$23,854,013.23**	**$47,803,412.54**	**$25,302,960.55**
Liquid Boilers	$42,064,030.21	$31,465,455.05	$42,246,559.19	$31,395,773.63
Coal Boilers	$1,381,306.23	$893,522.89	$4,893,793.90	$2,091,300.82
HCl Production Furnaces	$1,842,814.77	$1,842,814.77	$3,444,134.59	$3,444,134.59
Phase 2 Subtotal	**$45,288,151.21**	**$34,201,792.71**	**$50,584,487.67**	**$36,931,209.04**
Total	**$89,767,132.70**	**$58,055,805.94**	**$98,387,900.22**	**$62,234,169.59**

Private Engineering Costs: SDL Option 2

	SDL Option 2 Floor, w/ Cl Controls	SDL Option 2 Floor, w/o Cl Controls	SDL Option 2 BTF-D, w/ Cl Controls	SDL Option 2 BTF-D, w/o Cl Controls
Commercial Incinerators	$4,698,190.92	$2,037,899.93	$4,698,190.92	$2,037,899.93
Cement Kilns	$27,965,218.06	$17,693,435.65	$27,965,218.06	$17,693,435.65
LWAKs	$815,489.45	$815,489.45	$4,139,920.51	$2,264,436.78
Onsite Incinerators	$16,550,359.22	$4,792,531.87	$16,550,359.22	$4,792,531.87
Phase 1 Subtotal	**$50,029,257.65**	**$25,339,356.91**	**$53,353,688.71**	**$26,788,304.23**
Liquid Boilers	$60,449,413.61	$41,095,380.54	$60,711,650.14	$41,278,175.21
Coal Boilers	$1,834,543.61	$1,346,760.27	$6,864,742.06	$2,641,019.14
HCl Production Furnaces	$1,842,814.77	$1,842,814.77	$3,444,134.59	$3,444,134.59
Phase 2 Subtotal	**$64,126,771.98**	**$44,284,955.58**	**$71,020,526.79**	**$47,363,328.93**
Total	**$114,156,029.64**	**$69,624,312.48**	**$124,374,215.50**	**$74,151,633.16**

Number of Closed Systems, by Unit Type: Option 2

	SDL Option 2 Floor, w/ Cl Controls	SDL Option 2 Floor, w/o Cl Controls	SDL Option 2 BTF-D, w/ Cl Controls	SDL Option 2 BTF-D, w/o Cl Controls	Baseline Total
Commercial Incinerators	2	0	2	0	15
Cement Kilns	0	0	0	0	26
LWAKs	0	0	0	0	7
Onsite Incinerators	33	30	33	30	92
Liquid Boilers	29	20	29	21	107
Coal Boilers	2	2	2	2	12
HCl Production Furnaces	0	0	0	0	17
Total	66	52	66	53	276

Quantity of Waste Sent Offsite or Rerouted (tons): Option 2

	SDL Option 2 Floor, w/ Cl Controls	SDL Option 2 Floor, w/o Cl Controls	SDL Option 2 BTF-D, w/ Cl Controls	SDL Option 2 BTF-D, w/o Cl Controls
To Commercial Incinerators	48,230	26,766	48,230	26,766
To Cement Kilns or LWAKs	16,087	7,698	16,087	8,564
Non-commercial Consolidation	67,266	56,732	67,266	56,732
Total	131,582	91,196	131,582	92,062

Available Capacity at Commercial Facilities: Option 2

		Commercial Incinerators	Cement Kilns/LWAKs
Pre-MACT Capacity (tons)		188,193.00	504,875.53
Post-MACT (tons)	SDL Option 2 Floor, w/ Cl controls	112,866.84	488,788.88
	SDL Option 2 Floor, w/o Cl controls	161,426.70	497,177.63
	SDL Option 2 BTF-D, w/ Cl controls	112,866.84	488,788.88
	SDL Option 2 BTF-D, w/o Cl controls	161,426.70	496,311.83

Government Costs: Option 2

	Annual Cost
SDL Option 2 Floor, w/ Cl controls	$419,512.27
SDL Option 2 Floor, w/o Cl controls	$455,470.46
SDL Option 2 BTF-D, w/ Cl controls	$419,512.27
SDL Option 2 BTF-D, w/o Cl controls	$451,475.11

Number of Jobs Lost and Gained, by Unit Type: Option 2								
	SDL Option 2 Floor, w/ Cl controls		**SDL Option 2 Floor, w/o Cl controls**		**SDL Option 2 BTF-D, w/ Cl controls**		**SDL Option 2 BTF-D, w/o Cl controls**	
	Lost	*Gained*	*Lost*	*Gained*	*Lost*	*Gained*	*Lost*	*Gained*
Commercial Incinerators	47.8	18.4	0.0	10.6	47.8	18.4	0.0	10.6
Cement Kilns	0.0	145.8	0.0	96.9	0.0	145.8	0.0	96.9
LWAKs	0.0	5.4	0.0	5.4	0.0	29.0	0.0	14.7
Onsite Incinerators	245.2	51.0	223.4	15.7	245.2	51.0	223.4	15.7
Liquid Boilers	119.3	241.5	82.9	195.5	119.3	241.5	86.3	194.3
Coal Boilers	9.5	10.7	9.5	7.0	9.5	32.7	9.5	11.2
HCl Production Furnaces	0.0	13.8	0.0	13.8	0.0	24.1	0.0	24.1
APCD Industry	-	283.7	-	157.6	-	299.0	-	170.4
Total	**421.8**	**770.3**	**315.8**	**502.5**	**421.8**	**841.5**	**319.2**	**537.9**

Combustion Prices ($ per ton): SDL Option 2					
Waste Form	**Baseline Prices**	**SDL Option 2 Floor, w/ Cl Controls**	**SDL Option 2 Floor, w/o Cl Controls**	**SDL Option 2 BTF-D, w/ Cl Controls**	**SDL Option 2 BTF-D, w/o Cl Controls**
Inorganic Liquid (Halogenated)	$1,080.54	$1,111.15	$1,099.36	$1,114.22	$1,100.69
Inorganic Liquid (Nonhalogenated)	$127.05	$130.65	$129.26	$131.01	$129.42
Inorganic Sludge (Nonhalogenated)	$560.14	$576.01	$569.90	$577.60	$570.59
Inorganic Solids (NonHal)	$557.14	$572.92	$566.85	$574.51	$567.53
Lab Packs	$2,820.00	$2,899.89	$2,869.13	$2,907.89	$2,872.58
Gases	$940.00	$966.63	$956.38	$969.30	$957.53
Organic Liquids (Halogenated)	$1,080.54	$1,111.15	$1,099.36	$1,114.22	$1,100.69
Organic Liquids (NonHal)	$127.05	$130.65	$129.26	$131.01	$129.42
Organic Sludges (Halogenated)	$1,010.14	$1,038.76	$1,027.74	$1,041.62	$1,028.98
Organic Sludges (NonHal)	$560.14	$576.01	$569.90	$577.60	$570.59
Organic Solids (Halogenated)	$1,067.14	$1,097.37	$1,085.73	$1,100.40	$1,087.04
Organic Solids (NonHal)	$557.14	$572.92	$566.85	$574.51	$567.53

OPTION 3

Net Private Costs, by Unit Type: SDL Option 3				
	SDL Option 3 Floor, w/ Cl Controls	**SDL Option 3 Floor, w/o Cl Controls**	**SDL Option 3 BTF-D, w/ Cl Controls**	**SDL Option 3 BTF-D, w/o Cl Controls**
Commercial Incinerators	-$15,216,727.09	-$9,382,100.40	-$15,897,834.01	-$9,682,618.40
Cement Kilns	$1,736,297.03	$1,177,655.95	-$886,739.70	-$91,535.02
LWAKs	-$1,143,437.54	-$427,109.79	$1,938,973.22	$941,794.39
Onsite Incinerators	$12,236,289.96	$3,951,805.13	$12,240,719.45	$3,953,144.86
Phase 1 Subtotal	**-$2,387,577.64**	**-$4,679,749.11**	**-$2,604,881.04**	**-$4,879,214.18**
Pre-existing customers of commercial combustion facilities	**$35,266,378.27**	**$22,362,839.41**	**$38,518,925.61**	**$23,800,882.78**
Liquid Boilers	$54,662,219.58	$39,170,275.21	$54,857,663.51	$39,278,217.96
Coal Boilers	$1,511,485.56	$1,022,652.72	$5,025,971.52	$2,222,280.96
HCl Production Furnaces	$1,825,249.10	$1,825,249.10	$4,063,291.11	$4,061,001.70
Phase 2 Subtotal	**$57,998,954.24**	**$42,018,177.02**	**$63,946,926.13**	**$45,561,500.62**
Total	**$90,877,754.87**	**$59,701,267.32**	**$99,860,970.70**	**$64,483,169.22**

Upgrade Expenditures, by Unit Type: SDL Option 3				
	SDL Option 3 Floor, w/ Cl Controls	SDL Option 3 Floor, w/o Cl Controls	SDL Option 3 BTF-D, w/ Cl Controls	SDL Option 3 BTF-D, w/o Cl Controls
Commercial Incinerators	$4,224,525.39	$2,148,236.27	$4,224,525.39	$2,148,236.27
Cement Kilns	$29,743,955.17	$19,472,172.77	$29,743,955.17	$19,472,172.77
LWAKs	$887,076.65	$887,076.65	$4,150,527.94	$2,336,023.97
Onsite Incinerators	$12,031,916.34	$3,862,966.92	$12,031,916.34	$3,862,966.92
Phase 1 Subtotal	**$46,887,473.55**	**$26,370,452.61**	**$50,150,924.84**	**$27,819,399.93**
Liquid Boilers	$51,734,745.94	$36,499,149.67	$51,925,884.96	$36,605,325.20
Coal Boilers	$1,379,573.19	$891,789.85	$4,893,793.90	$2,091,300.82
HCl Production Furnaces	$1,825,249.10	$1,825,249.10	$3,780,695.19	$3,780,695.19
Phase 2 Subtotal	**$54,939,568.22**	**$39,216,188.61**	**$60,600,374.04**	**$42,477,321.21**
Total	**$101,827,041.77**	**$65,586,641.23**	**$110,751,298.88**	**$70,296,721.14**

Private Engineering Costs: SDL Option 3

	SDL Option 3 Floor, w/ Cl Controls	SDL Option 3 Floor, w/o Cl Controls	SDL Option 3 BTF-D, w/ Cl Controls	SDL Option 3 BTF-D, w/o Cl Controls
Commercial Incinerators	$4,793,785.11	$2,148,236.27	$4,793,785.11	$2,148,236.27
Cement Kilns	$29,743,955.17	$19,472,172.77	$29,743,955.17	$19,472,172.77
LWAKs	$887,076.65	$887,076.65	$4,150,527.94	$2,336,023.97
Onsite Incinerators	$17,012,345.65	$5,474,939.65	$17,012,345.65	$5,474,939.65
Phase 1 Subtotal	**$52,437,162.59**	**$27,982,425.34**	**$55,700,613.88**	**$29,431,372.66**
Liquid Boilers	$67,595,056.06	$46,048,070.44	$67,793,126.46	$46,161,177.35
Coal Boilers	$1,832,155.84	$1,344,372.50	$6,864,742.06	$2,641,019.14
HCl Production Furnaces	$1,825,249.10	$1,825,249.10	$4,090,382.62	$4,090,382.62
Phase 2 Subtotal	**$71,252,461.00**	**$49,217,692.04**	**$78,748,251.14**	**$52,892,579.11**
Total	**$123,689,623.59**	**$77,200,117.38**	**$134,448,865.02**	**$82,323,951.77**

Number of Closed Systems, by Unit Type: Option 3

	SDL Option 3 Floor, w/ Cl Controls	SDL Option 3 Floor, w/o Cl Controls	SDL Option 3 BTF-D, w/ Cl Controls	SDL Option 3 BTF-D, w/o Cl Controls	Baseline Total
Commercial Incinerators	2	0	2	0	15
Cement Kilns	0	0	0	0	26
LWAKs	0	0	0	0	7
Onsite Incinerators	33	30	33	30	92
Liquid Boilers	27	26	27	26	107
Coal Boilers	2	2	2	2	12
HCl Production Furnaces	0	0	1	1	17
Total	64	58	65	59	276

Quantity of Waste Sent Offsite or Rerouted (tons): Option 3

	SDL Option 3 Floor, w/ Cl Controls	SDL Option 3 Floor, w/o Cl Controls	SDL Option 3 BTF-D, w/ Cl Controls	SDL Option 3 BTF-D, w/o Cl Controls
To Commercial Incinerators	48,230	26,766	48,230	26,766
To Cement Kilns or LWAKs	11,577	10,705	12,267	11,394
Non-commercial Consolidation	67,266	56,732	67,266	56,732
Total	127,072	94,203	127,762	94,892

Available Capacity at Commercial Facilities: Option 3

		Commercial Incinerators	Cement Kilns/LWAKs
Pre-MACT Capacity (tons)		188,193.00	504,875.53
Post-MACT (tons)	SDL Option 3 Floor, w/ Cl controls	112,866.84	493,298.55
	SDL Option 3 Floor, w/o Cl controls	161,426.70	494,170.81
	SDL Option 3 BTF-D, w/ Cl controls	112,866.84	492,608.96
	SDL Option 3 BTF-D, w/o Cl controls	161,426.70	493,481.22

Government Costs: Option3

	Annual Cost
SDL Option 3 Floor, w/ Cl controls	$427,502.98
SDL Option 3 Floor, w/o Cl controls	$431,498.33
SDL Option 3 BTF-D, w/ Cl controls	$423,507.62
SDL Option 3 BTF-D, w/o Cl controls	$427,502.98

Number of Jobs Lost and Gained, by Unit Type: Option 3

	SDL Option 3 Floor, w/ Cl controls		SDL Option 3 Floor, w/o Cl controls		SDL Option 3 BTF-D, w/ Cl controls		SDL Option 3 BTF-D, w/o Cl controls	
	Lost	*Gained*	*Lost*	*Gained*	*Lost*	*Gained*	*Lost*	*Gained*
Commercial Incinerators	47.8	18.7	0.0	11.3	47.8	18.7	0.0	11.3
Cement Kilns	0.0	154.2	0.0	105.3	0.0	154.2	0.0	105.3
LWAKs	0.0	5.7	0.0	5.7	0.0	29.0	0.0	15.0
Onsite Incinerators	245.2	53.6	223.4	18.5	245.2	53.6	223.4	18.5
Liquid Boilers	113.3	303.8	109.0	229.2	113.3	303.8	109.0	229.2
Coal Boilers	9.5	10.7	9.5	7.0	9.5	32.7	9.5	11.2
HCl Production Furnaces	0.0	13.6	0.0	13.6	3.4	26.0	3.4	26.0
APCD Industry	-	310.5	-	173.2	-	326.2	-	187.0
Total	**415.8**	**870.7**	**341.9**	**563.7**	**419.2**	**944.2**	**345.2**	**603.5**

Combustion Prices ($ per ton): SDL Option 3

Waste Form	Baseline Prices	SDL Option 3 Floor, w/ Cl Controls	SDL Option 3 Floor, w/o Cl Controls	SDL Option 3 BTF-D, w/ Cl Controls	SDL Option 3 BTF-D, w/o Cl Controls
Inorganic Liquid (Halogenated)	$1,080.54	$1,113.01	$1,101.14	$1,116.01	$1,102.46
Inorganic Liquid (Nonhalogenated)	$127.05	$130.87	$129.47	$131.22	$129.63
Inorganic Sludge (Nonhalogenated)	$560.14	$576.97	$570.82	$578.53	$571.50
Inorganic Solids (NonHal)	$557.14	$573.88	$567.76	$575.43	$568.44
Lab Packs	$2,820.00	$2,904.75	$2,873.75	$2,912.58	$2,877.22
Gases	$940.00	$968.25	$957.92	$970.86	$959.07
Organic Liquids (Halogenated)	$1,080.54	$1,113.01	$1,101.14	$1,116.01	$1,102.46
Organic Liquids (NonHal)	$127.05	$130.87	$129.47	$131.22	$129.63
Organic Sludges (Halogenated)	$1,010.14	$1,040.50	$1,029.39	$1,043.30	$1,030.64
Organic Sludges (NonHal)	$560.14	$576.97	$570.82	$578.53	$571.50
Organic Solids (Halogenated)	$1,067.14	$1,099.21	$1,087.48	$1,102.17	$1,088.79
Organic Solids (NonHal)	$557.14	$573.88	$567.76	$575.43	$568.44

APPENDIX C

Exhibit C-1

Emissions Reductions Achieved Under the Revised Agency Preferred Approach

	Particulate Matter (tons/yr)[a]	Mercury (tons/yr)	Dioxin/Furans (grams/yr)	Chlorine (tons/yr)	SVM/LVM (tons/yr)
Cement Kilns	43 (0.11)	0.23	0	64	1.14
Incinerators	0 (0)	0	0.28	289	0.45
LWAKs	0 (0)	0.004	1.91	0	0.02
Coal Boilers	437 (5.42)	0.02	0	421	1.34
HCl Production Furnaces	0 (0)	0	2.29	144	0
Liquid Boilers	1,247 (2.41)	0.68	0.20	659	11.40
TOTAL: Revised Proposal[b]	1,727 (7.94)	0.93	4.69	1,577	14.35
TOTAL: 2004 Assessment	2,215 (9.67)	0.93	4.69	2,638	16.41

Notes:

a. Numbers in parentheses after the estimates of PM emissions reductions represent reductions in non-enumerated metals emissions associated with the PM standards. The non-enumerated metals are manganese, cobalt, nickel, antimony, and selenium.

b. Totals may not add due to rounding.